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REMOTE SENSING SURVEY OF THE MISSISSIPPI RIVER GULF OUTLET, OCEAN DREDGED MATERIAL DISPOSAL SITE, PLAQUEMINES PARISH, LOUISIANA

Final Report

May 2001

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1260 Main Street
Baton Rouge, Louisiana

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In June 1999, a cultural resources remote-sensing survey was conducted in the approximately 5,000-acre Ocean Dredged Material Disposal Site (ODMDS) of the Mississippi River Gulf Outlet (MRGO) located near Breton Island just northeast of the entrance to the Mississippi River in Plaquemines Parish, Louisiana. The purpose of the survey was to locate historic shipwrecks or other underwater cultural resources that may exist in the project area. The remote-sensing survey located a number of magnetometer and side-scan sonar targets. The vast majority of these are related to identifiable oil and gas structures, such as pipelines and well sites, or to trash and debris, such as pieces of pipe and cable. Six targets exhibited some of the magnetic and/or side-scan sonar characteristics of known historic shipwrecks. These targets were examined in more detail and all but one are believed to be related to modern debris. The source of the one target could not be ascertained with the available data and it is recommended that it be identified through diver examination.

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by

Charles E. Pearson

Performed under contract with the:
New Orleans District
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Principal Investigator

ABSTRACT

In June 1999, a cultural resources remote-sensing survey was conducted in the approximately 5,000-acre Ocean Dredged Material Disposal Site (ODMDS) of the Mississippi River Gulf Outlet (MRGO) located near Breton Island just northeast of the entrance to the Mississippi River in Plaquemines Parish, Louisiana. The purpose of the survey was to locate historic shipwrecks or other underwater cultural resources that may exist in the project area. The remote-sensing survey located a number of magnetometer and side-scan sonar targets. The vast majority of these are related to identifiable oil and gas structures, such as pipelines and well sites, or to trash and debris, such as pieces of pipe and cable. Six targets exhibited some of the magnetic and/or side-scan sonar characteristics of known historic shipwrecks. These targets were examined in more detail and all but one are believed to be related to modern debris. The source of the one target could not be ascertained with the available data and it is recommended that it be identified through diver examination.

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CHAPTER 1

INTRODUCTION

This report presents the results of a remote-sensing survey undertaken by Coastal Environments, Inc., to locate and assess underwater cultural resources within the Ocean Dredged Material Disposal Site (ODMDS) of the Mississippi River Gulf Outlet (MRGO) located in Breton Sound, Louisiana. This designated project area lies just to the east of Breton Island and measures approximately 16 mi (25.8 km) long and 0.5 mi (0.8 km) wide and encompasses approximately 5,000 acres along the western side of the MRGO at its southern end (Figure 1-1). The Corps of Engineers, New Orleans District, periodically dredges the MRGO and deposits dredged material into the ODMDS. Because of the potential of historic shipwrecks or other underwater cultural resources existing in the disposal area, the New Orleans District undertook the cultural investigations reported here in compliance with Federal rules and regulations (particularly 36 CFR 800, Section 106 of the National Historic Preservation Act of 1966, the Archeological and Historic Preservation Act of 1974 and the Abandoned Shipwreck Act of 1987).

Breton Sound has been utilized by various types of watercraft since the French passed along the coast and by Breton Island on their way to the mouth of the Mississippi River early in 1699. It, also, is likely that prehistoric populations visited Breton Island and adjacent islands using dugout canoes. Despite a long period of use, watercraft activity in the Breton Island area, apparently, has never been intensive until very recently. Breton Island has never served as a major port or landing area and no major navigation routes passed through the project area prior to the construction of the MRGO in the 1950s-1960s. The heaviest use of the project area by boats has occurred during the past 50 years, principally by shrimping and fishing vessels of various sorts, and by other commercial vessels using the MRGO and the nearby Baptiste Collette Bayou which provides access for fairly large vessels into the Mississippi River at the town of Venice. The majority of these non-fishing vessels are associated with the oil and gas industry.

Thus, while Breton Island has never been an important port of call, numerous vessels, particularly small coastal craft, have passed by the island and across or near the project area as they traveled to and from coastal ports or as they fished the waters of Breton Sound. Rising only a few feet above the surface of the water, Breton Island, and other nearby islands and shallow shoals, certainly represented hazards to vessels passing by or those seeking shelter during storms. Over the past 300 years some of these watercraft must have been lost, although historical accounts of sinkings near Breton Island are rare. The remoteness of Breton Island and the fact that most of the vessels lost in the area are likely to have been small, local fishing boats has probably contributed to this lack of recorded shipwrecks. Today, the remains of a number of modern vessels, such as shrimp trawlers and tow boats, can be seen in the waters surrounding Breton Island. There is every reason to believe that similar losses have occurred in the past, very possibly within the project area, but have gone unreported.

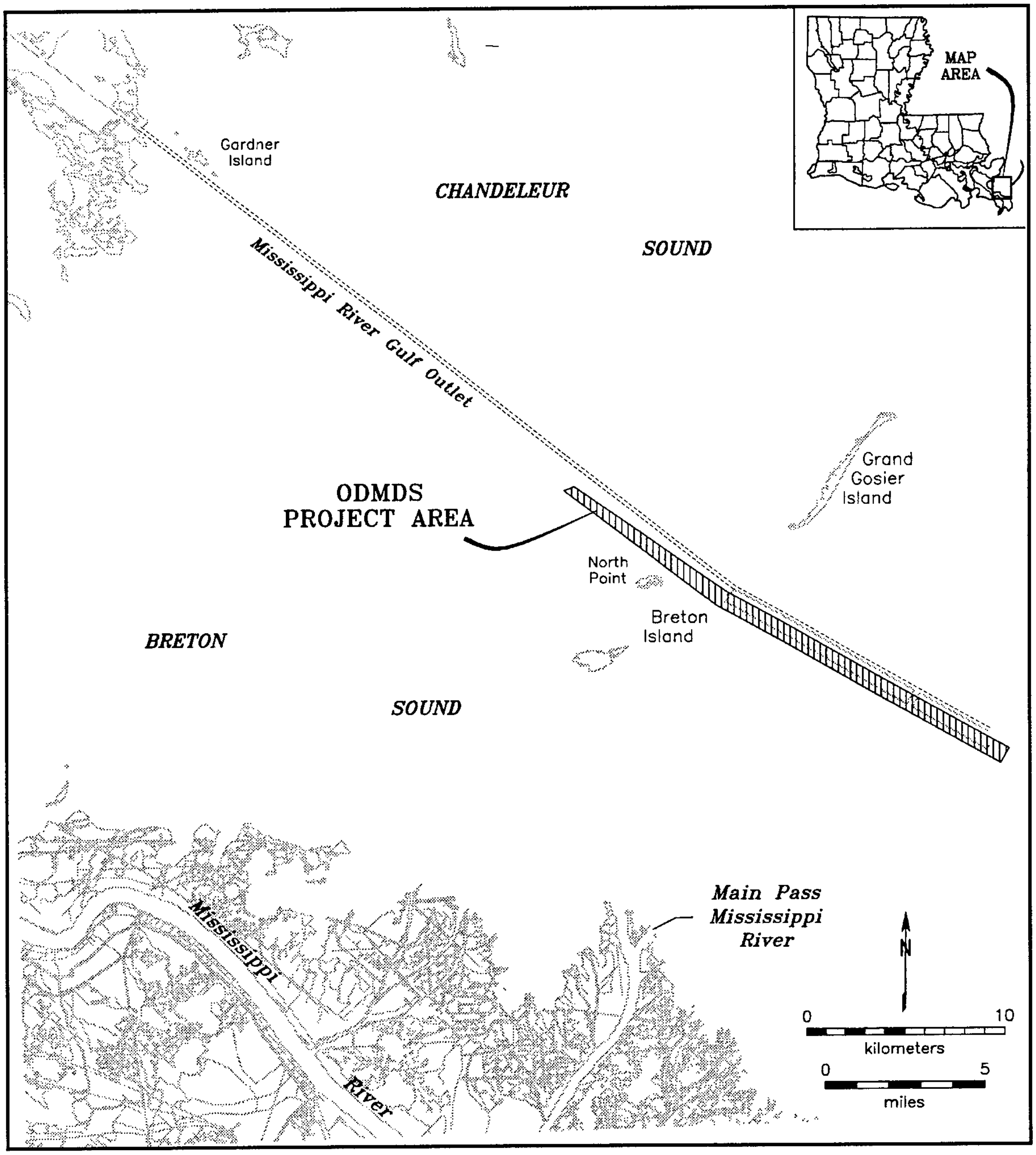


Figure 1-1. The location of the Mississippi River Gulf Outlet (MRGO), Offshore Dredged Material Disposal Site (ODMDS) project area.

This study involved background historical research and a systematic remote-sensing survey of the approximately 5,000-acre project area. The instruments used in the remote-sensing survey were the proton precession magnetometer, side-scan sonar and fathometer. Positioning during the survey was provided by a differential GPS system. The magnetometer, fathometer and positioning systems were connected to an onboard computer and all of these data were digitally collected and stored using a navigation program called *HyPack*. In the last

two decades these instruments have become standard components in the array of equipment used in searching for shipwrecks. Later sections of this report provide details on this equipment and the conduct and results of the remote-sensing survey. It is important to recognize that these instruments, in general, can most easily detect larger historic craft such as steamboats, seagoing ships, large fishing boats, etc., particularly those containing large quantities of ferrous metal. Smaller boats or other cultural materials without iron elements may exist as wrecks or resources in the project area; however, they are much more difficult to locate and identify.

In conjunction with the remote-sensing survey, data on the geological history and shipwreck potential of the project area were collected. This information provided a background against which the results of the remote-sensing data could be interpreted. Interpretation relied on the information available on vessel losses in the project area and on past impacts that natural and man-induced activities may have had on wrecks in the ODMDS. Identification and evaluation of these impacts were derived, in part, from assumptions about various effects that these forces would have on a sunken vessel. Interpretation of remote-sensing data also drew upon the available literature on similar shipwreck surveys. Each of these factors are discussed in the following chapters.

The data developed in this study provide the New Orleans District with knowledge of the cultural resources potential of the project area. In addition, it is hoped that the information provided here will serve as a contribution to the District's overall management of cultural resources. This study also provides a contribution to the expanding body of literature dealing with the application of remote-sensing survey in the search for shipwrecks.

The Project Area

The project area extends in a northwest-southeast direction along the western side of the MRGO for almost 16 mi, passing between the maintained channel of the MRGO and Breton Island (see Figure 1-1). The project area has a slight "dogleg" in it just east of Breton Island, so for convenience it was divided into two segments. The southern segment (designated Area 1) is rectangular in shape, measuring 10 mi (16.1 km) long and 2900 ft (881 m) wide. The northern section (designated Area 2) is trapezoidal in shape, measuring 5.9 mi (9.5 km) long and 2900 ft wide at its southern end, but only approximately 1600 ft (488 m) wide at its northern end (see Figure 1-1). Water depths at the upper or northern end of Area 2 were about 15 ft (4.5 m), while the deepest portion of the project area was at the lower end of Area 1, where depths reached 45 to 47 ft (13.7 to 14.3 m). The sea bottom in the project area is sloping, but relatively flat, although, a fairly large bar or shoal rises to within 13 ft of the surface in the northern half of Area 1. Also, several large features that appear as irregularly-shaped rises or "hummocks" on the bottom were observed in the lower portion of Area 2. These are believed to be relatively recent deposits of dredged material that have not been dispersed by currents or waves. In fact, during most of the period of the remote-sensing survey, a cutter head dredge was working in the MRGO just southeast of Breton Island and dredged material was being pumped through a submerged pipe across the project area to the island. This was being done to replace sediments lost the previous year during Hurricane Georges (Joan Exnicious, personal communication 1999). Some of the recent dredge deposits seen on the bottom in the project area may have come from accidental spillage related to this island restoration activity.

Breton Sound has been the locus of oil and gas activity since the 1940s. Today, numerous oil and gas platforms, consisting of operating as well as abandoned wells, are scattered all around the project area. In addition, numerous pipelines of various types and sizes criss-cross the waters of Breton Sound. Several of these pipelines cross the project area and were recorded during the remote-sensing survey. Some of these are physically marked and/or

appear on various maps, others are neither marked nor mapped. A number of oil or gas platforms and well heads are located just outside Area 1 near its lower (southern) end; however only one standing well head is in the project area. This well head, identified as Kerr-McGee No. 1, is located near the northern center of Area 2.

Report Organization

The following chapter places the project area in its natural and cultural setting by presenting discussions on its natural and cultural history. This review emphasizes the navigation history of the area and includes discussions on shipwreck probability and preservation potential and lists the available information on known watercraft losses in and near the project area. Chapter 3 provides discussions on the conduct and results of the remote-sensing survey. Finally, Chapter 4 presents conclusions and recommendations derived from analyses of the collected data.

CHAPTER 2

NATURAL AND CULTURAL SETTING

The project area is located in the shallow waters of coastal Louisiana and extends from the large coastal bay known as Breton Sound into the nearshore waters of the Gulf of Mexico. The project area lies along the eastern side of Breton Island, the westernmost island in the Chandeleur Island chain. Although open water today, in the fairly recent past this area lay within or at the edge of one of the major Mississippi River delta complexes, known as the St. Bernard Delta Complex. Loss of river flow through the distributaries of the St. Bernard Delta has resulted in significant deterioration and retreat of deltaic landforms, leaving open Gulf and bay waters in their place. The islands in the Chandeleur Island chain, which extends for 62 mi (100 km) from the western end of Mississippi Sound to Breton Island near the modern Mississippi River, are formed from reworked sandy sediments of the now-eroded St. Bernard Delta. The geology and geomorphology of coastal Louisiana, including the project area, has been extensively studied and is relatively well known. The information on the natural setting of the project area presented here has drawn from this previous work, particularly as it is synthesized in Irion et al. 1993 and Irion and Heinrich 1993.

Geological Setting and History of the Project Area

Water depths in the project area range from about 15 ft at the extreme northern end to about 45 ft at the southern end. The seafloor, generally, slopes toward the south, although the bottom is somewhat uneven as a result of submerged bar formation and bottom scouring within tidal inlets. The sediments underlying the project area consist of a "complex assemblage of Pleistocene and Holocene and deltaic, neashore marine, and coastal sedimentary deposits" (Irion and Heinrich 1993:7). Shepard (1956) has identified several sedimentary environments in the surficial seafloor deposits in this area, each characterized by a distinctive pedology, reflective of different geologic histories. The seafloor sediments in the upper portion of the project area have been identified as "open lagoon" sediments (Figure 2-1). The bottom sediments in the central and much of the southern portion of the study area are classified as "open lagoonal inlet" sediments. Also found in the southern portion of the project area are "reworked Mississippi Delta" sediments (see Figure 2-1).

The "open lagoonal" sedimentary environment is found to the north of Breton Island, within Breton Sound. Surficial sediments here are principally fine-grained particles derived from infilling of the open waters of Breton Sound. The "open lagoonal inlet" environment extends along the eastern and southern sides of Breton Island and occupies tidal inlets that have cut into the reworked surface of the underlying St. Bernard Delta. One of these inlets lies between Breton Island and Grand Gosier Island to the northeast, while the other lies between Breton Island and the modern Mississippi River delta to the southwest (Figure 2-1) (Irion and Heinrich 1993:5). Surface sediments in the "open lagoonal inlet" environment consist principally of clayey silt with varying amounts of sand. The distribution of sand content varies

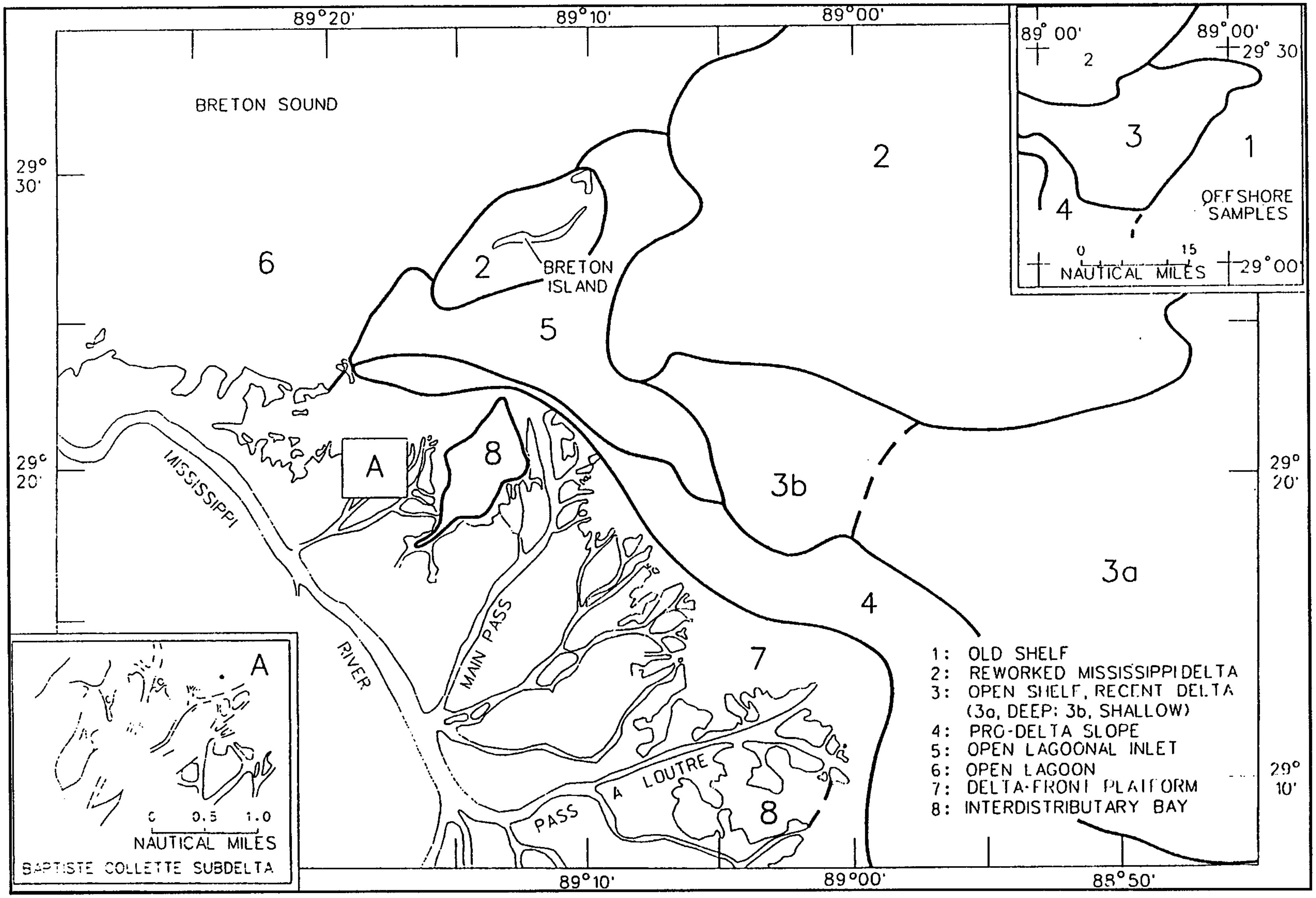


Figure 2-1. Areal distribution of sedimentary environments in the Breton Island area (source: Curtis 1960:476, in Irion et al. 1993:Fig. 2).

in relation to the current flow through the two inlets. Sand content near the centers of the inlets varies from 1 to 20 percent, while it forms as much as 80 percent of sediment content near the edges of the inlets (Shepard 1956). The "reworked Mississippi Delta" sedimentary environment consists of reworked deposits derived from the former surface of the St. Bernard Delta Complex. The surficial sediments of this environment consist mainly of sand. As noted, Breton Island and the other islands in the Chandeleur Island chain consist principally of these reworked sands.

The geological history of the Breton Island area is discussed in detail by Irion and Heinrich (1993) and their information is summarized here. Figure 2-2 presents a geologic cross-section of the Chandeleur Barrier Island chain that shows the major geologic features underlying the project area. The deepest structure is the Pleistocene-aged Prairie Complex, the surface of which now lies at a depth of 164 to 197 ft (50 to 60 m) below sea level in the project area. Although now deeply buried by more recent Holocene deltaic and nearshore deposits, when sea levels were much lower the surface of the Prairie Complex was subaerially exposed and constituted the Louisiana coastal plain. The surface of the Prairie Complex in this area was probably flooded by rising seas sometime after 10,000 to 9,000 years B.P. (Irion and Heinrich 1993:16).

Lying on top of the Prairie Complex surface is a thick wedge of Holocene-aged deposits consisting of deltaic sediments of the St. Bernard Delta Complex (Figure 2-2). The St. Bernard Delta Complex is bounded by a lower marine erosional surface, known as a "ravinement surface," formed as rising seas crossed and inundated the surface of the Prairie Complex. The upper boundary of the St. Bernard Delta Complex is another erosional surface, formed when the delta deteriorated and became covered by Gulf waters. The sediments between these two erosional boundaries are approximately 148 to 164 ft (45 to 50 m) thick and consist of fine-grained, progradational deltaic sediments deposited as the St. Bernard Delta expanded across this region between approximately 1800 and 3400 years B.P (Weinstein and Gagliano 1985:Fig. 1). As shown in Figure 2-2, Penland et al. (1985) have identified two lobes of the St. Bernard Delta Complex underlying the Chandeleur Island chain on the basis of a minor unconformity, or "diastem," seen within the deltaic deposits. The delta lobe beneath the project area is identified as "Unnamed Delta Lobe No. 9."

As the St. Bernard Delta Complex prograded seaward, it incorporated a number of depositional environments and features, including prodelta facies, delta front facies, natural levees, backswamps, marshes, etc. At about 3400 years B.P., the St. Bernard Delta Complex had overextended its distributary network and become an inefficient carrier of water flow and, as a result, the trunk channel shifted to a shorter and more efficient course, abandoning the St. Bernard system (Fisk 1960). By this time, the seaward edge of the delta features were some distance south of the present-day Chandeleur Islands. With abandonment and loss of its source of sediment, the St. Bernard Delta system began to erode at its extremities, plus compaction and eustatic sea level rise led to subsidence of the plain of the complex beneath the waters of the Gulf of Mexico (Irion and Heinrich 1993:16). Erosion at the delta margins removed fine-grained sediments, leaving behind sands and a landward-migrating beach at the shoreface edge of delta features. Later, longshore currents transported sand away from the principal delta lobes creating a line of spit and barrier island features. Ultimately, continued erosion plus subsidence of the former delta plain led to the formation of Chandeleur and Breton sounds, leaving the sandy beaches, spits and islands isolated as the present Chandeleur Island system (Irion and Heinrich 1993:16), identified as the Chandeleur Complex in Figure 2-2.

The Chandeleur Island Complex represents the uppermost geological formation in the project area and, essentially, consists of the various islands and spits in the Chandeleur Island chain. The basal portion of this complex, typically, consists of heavily bioturbated lagoonal sediments composed of fine-grained deposits that formed in the lagoonal setting behind the

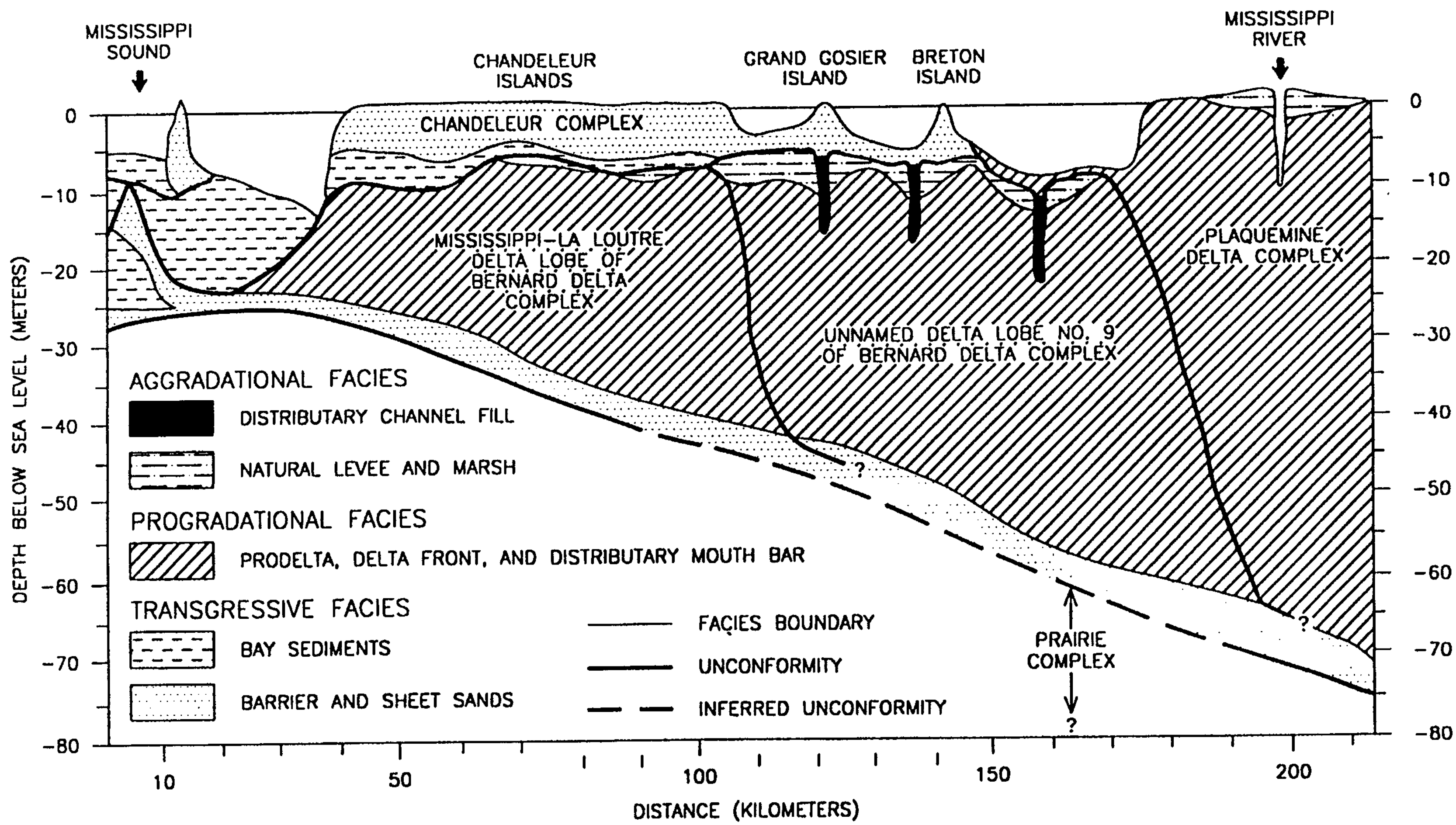


Figure 2-2. Geologic cross-section of the Chandeleur Barrier Chain (source: Irion and Heinrich 1993:Figure 4).

Chandeleur Islands. On top of these lagoonal sediments are several meters of silty sand and sand deposits, which form the body of the Chandeleur Islands. The sandy deposits, commonly, consist of washover and dune deposits and the islands in the past and today are continually being impacted and altered by wave action from storms and hurricanes as well as from wind. As a result, there is a slow but continuous landward migration of the island features.

Seaward of the barrier islands themselves is a 10- to 15-m-thick formation of sandy, tidal inlet and channel fill deposits. These deposits consist of upward fining bioturbated sands that contain numerous shells and shell fragments (Irion and Heinrich 1993:13; Penland et al. 1985, 1987).

Modern Natural Setting

Today, the exposed portions of the barrier islands in the Chandeleur Island chain consist of low, sandy dune and beach features on which are growing various types of sea-tolerant grasses and shrubs. Breton Island, the westernmost island of the chain, is an arc-shaped feature measuring about 3 mi (4.8 km) long and about 0.5 mi (0.8 km) wide at its widest point. The low sand dunes on the island rise no more than about 6 ft (2 m) above the water surface. Originally a single entity, the island today is divided into two parts as a result of erosion and washovers (Figure 2-3). The small islet comprising the northeastern segment is sometimes referred to as "North Point," while the slightly larger, southwestern islet is generally referred to as Breton Island proper. A shallow bar, portions of which are exposed at very low water, connects these two remaining island segments. The division of the island into two portions has led modern maps to use the plural designation "Breton Islands" to refer to what until fairly recently was a singular entity (National Oceanic and Atmospheric Administration [hereinafter cited NOAA] 1992).

Louisiana leads the nation in the loss of its wetlands and in coastal erosion. Erosion of the state's barrier islands, in places, exceeds 65 ft (20 m) per year. Overall, Louisiana's barrier islands have decreased by more than 40 percent on the average and some islands have lost 75 percent of their areas within the past 100 years. The trend of land loss is expected to continue for years to come. The physical processes that cause this erosion are complex and there is debate and controversy over which cause is the most significant and on which measures would alleviate coastal land loss (Williams et al. 1992:1). Breton Island, and the other islands in the Chandeleur system, like most of the state's other barrier islands, are extremely fragile and vulnerable to erosion and other impacts from natural forces. Penland et al. (1985) have plotted the shoreline changes in the Chandeleur Barrier Island chain over the past 100 years and demonstrated the landward migration of the entire system, plus the continuous changes in the configuration of various individual islands from erosion (see Figure 2-3). In fact, during the course of the present survey, sand was being pumped onto Breton Island to restore sediments removed during a recent hurricane.

Historical Setting of the Project Area

The following discussion presents an overview of the history of the region around the project area with an emphasis on its navigation history. As noted earlier, although various types of watercraft are known to have traveled the waters near Breton Island since the earliest period of historic contact, the area has never been the locus of a major landing or port.

The earliest accounts of Breton Island and Breton Sound are derived from the explorations of the Canadian-born Pierre LeMoyne, Sieur d'Iberville, who led the establishment and settlement of the territory of Louisiana for the French in 1698-1699. However, even prior to the French activity on the area, it is presumed that aboriginal

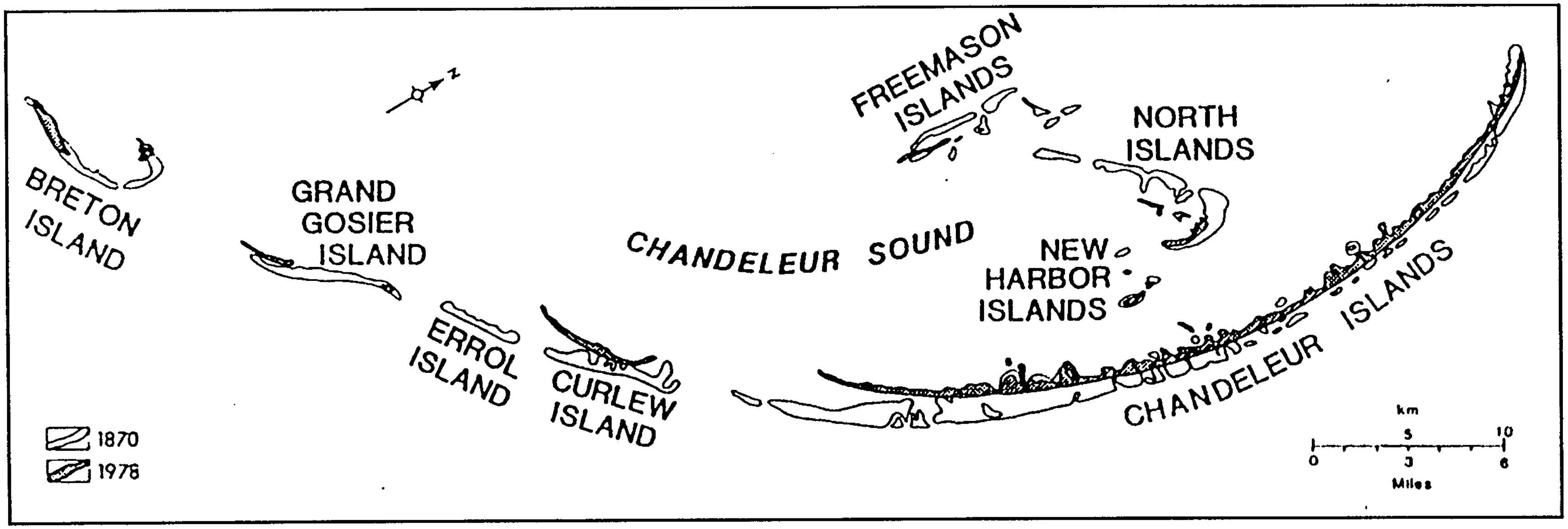


Figure 2-3. Shoreline changes in the Chandeuleur Island chain between 1870 and 1978 (source Penland et al. 1985, in Irion and Heinrich 1993:Figure 6).

populations traveled the shallow waters of Breton Sound in dugout canoes (Pearson et al. 1989). The discovery of prehistoric dugouts around the state of Louisiana, plus copious historic accounts of their use, leave no doubt that prehistoric peoples had the means to travel to Breton Island; however, no evidence of archaeological sites have been reported on the island. Breton Island, and the other barrier islands of Louisiana, probably offered specific types of resources that attracted visits by native peoples. In particular, because these islands serve as nesting ground for many types of shore and sea birds, their eggs would have constituted a seasonally abundant and easily exploited food source. Additionally, in the past various species of sea turtles came ashore to lay on the Chandeleur Islands (Dundee and Rossman 1989:170-172) and their eggs, as well as the turtles themselves, could have been easily collected or captured. The rather harsh living conditions on Breton Island, presumably, inhibited any long term or permanent settlement; visits were probably brief as well as seasonal and confined to collecting desired resources.

In late 1698, Iberville departed France with three ships laden with French and Canadian settlers bound for the coast of present-day Alabama and Mississippi. On January 31, 1699, he anchored off Mobile Bay, but soon moved his ships to a more protected anchorage at Ship Island (originally called *Isle Mouillage*, or Anchorage Island, as well as *Isle aux Vaisseaux*, or Ship Island) in present-day Mississippi. One of his first objectives was to explore the coast from his base at Ship Island. He was particularly interested in reaching and examining the Mississippi River (Giraud 1974:31). On February 27, Iberville with a party of about 50 in two "Biscayan longboats" and two bark canoes departed Ship Island to reach the mouth of the Mississippi. The party traveled in the shallow waters along the coast of southeastern Louisiana, between the mainland and a series of islands of "grass and sand," Iberville's first description of the low islands in the Chandeleur chain (McWilliams 1981:49). On March 2, Iberville's journal records that the expedition passed "between a cape and a barren island, which lies two leagues east of the point and which may be three leagues in circumference. Between them, one-half league off the cape, I found eighteen feet of water: I am sure that it is no deeper further offshore" (Brasseaux 1981:38). Iberville then sailed to the south-southeast reaching the mouth of Main Pass, the eastern entrance to the Mississippi River, later that same day. Based on this account, it seems very likely that the island thought to be "three leagues in circumference" that Iberville saw on February 2 was what came to be known as Breton Island. If so, this marks the first known mention of the island.

Subsequent to Iberville's voyage, the passage along the coast inside of the Chandeleur Islands became one of the common routes of travel for the French to reach the mouth of the Mississippi from their settlements at Biloxi and Mobile (Pearson et al. 1989:85). However, the French, also, used two shorter routes to reach the Mississippi, both of which crossed Lake Pontchartrain, one reaching the river through Bayou St. John and the other through Bayou Manchac. Additionally, minor routes extended through the relict waterways of the old St. Bernard Delta system to the lower Mississippi River in the vicinity of Fort de la Boulaye, established in 1700 (Pearson et al. 1989:88). Some of these routes did cross parts of Breton Sound, using sections of the older coastal route. The coastal passage, although used, became less favored than other routes because it involved the longest distance and, also, the greatest potential for rough seas and other weather hazards.

Breton Island was not an extremely prominent landscape feature in the area and received minimal attention from early travelers. It was large enough to be named, but even the circumstances of its naming are unknown. Giraud (1974:660) notes that Breton Island is one of the earliest French place names applied to the area, but when and exactly why it was assigned to this particular feature is unknown. The name itself, obviously, refers to a native of the province of Brittany on the French coast opposite England. Brittany was famous for its seamen and the island (and Breton Sound) may have been named for Breton sailors in general or, possibly, a specific individual. At least one early map, however, suggests that the island

was not originally named Breton. The earliest map made after Iberville's explorations of Louisiana was that of the geographer Guillaume de L'Isle, produced in 1702. On this map, the island now known as Breton Island was named "Isle St. Pierre." De L'Isle's map relied primarily on information collected by Pierre-Charles Le Sueur, as well as others with Iberville and his brother, Jean Baptiste le Moyne, sieur de Bienville. Le Sueur traveled up the Mississippi River in 1700 with a group of *engages* (hired men) to exploit copper and other minerals on the upper river (McWilliams 1981:117). An account of Le Sueur's trip, left by a member of the party, Andre Penicaut, indicates that the company traveled across Lake Pontchartrain and portaged to the Mississippi at the western end of the lake; they apparently did not take the coastal route through present-day Breton Sound (McWilliams 1981). Thus, it seems unlikely that the name St. Pierre was given to the island by Le Sueur. The name may have been conferred by Iberville or Bienville, however, this is uncertain. Most subsequent maps indicate that the island is called "Isle aux Bretons" or some variation of the name, suggesting that the name "St. Pierre" was used for only a short time. For example, the de L'Isle map of 1718 (de L'Isle 1718), the D'Anville map of 1732 (D'Anville 1732), the 1744 map by Jaques N. Bellin (Bellin 1744) and the map produced by the English cartographer George Gauld from surveys done in 1778 (Ware 1982) all show the island named "Isle aux Bretons" or some variation of this. However, one later map has been found that uses the original name, "Isle St. Pierre." This is a map produced in the 1736 edition of a geography by Abraham Du Bois. It is possible that this map draws on the 1702 de L'Isle map for some of its information or that both names were sometimes used up to the 1730s.

There is no evidence that Breton Island was utilized as a landing or anchorage during these early years. However, it does appear that the tidal pass that today runs along the eastern side of the island was recognized as a navigation route during this time period. As noted above, Iberville commented on the deep water in the vicinity of the island, possibly a reference to the tidal channel. George Gauld's famous map entitled *Chart of the Coast of West Florida, and the Coast of Louisiana*, derived from surveys made in the late 1770s, shows a line of soundings running roughly north to south along the eastern side of Breton Island. These soundings extend from the coast on the north side of Breton Sound, almost due north of Breton Island, southward along the east side of the island and continue south to the birdfoot delta of the Mississippi River, ending just north of the entrance to Pass a l'Outre (Ware 1982). It seems likely that these soundings were made along a recognized route of travel; principally one that provided access from the interior water routes of present-day St. Bernard Parish into the Gulf of Mexico. This tidal pass extending along the eastern side of Breton Island is sometimes referred to as "Breton Island Pass."

Some naval activity occurred in the vicinity of Breton Island during the late nineteenth century and during the War of 1812. In 1794, the Spanish governor of Louisiana, Carondelet, reported that naval vessels were anchored at "Ship [navios] Island, the Chandeleurs, and Breton Island" (Robertson 1911:320). Twenty years later, during their attempt on New Orleans in the waning days of the War of 1812, the British anchored warships off the Chandeleur Islands (Irion et al. 1993:21). There is no record, however, that any engagements took place near or on Breton Island itself.

Through the nineteenth century, the waters of Breton Sound, including those around Breton Island, were traveled by a variety of vessels. Most of these tended to be smaller boats, including coastal sloops and schooners as well as local fishing vessels. Some of the smaller sailing and steam vessels traveling to and from the mouth of the Mississippi River would have traveled across the waters of Breton sound, but the larger ships stayed outside of the Chandeleur Island chain in the deeper waters of the Gulf of Mexico. Also, a considerable amount of the coastal traffic between New Orleans and points east used the shorter and safer route along Mississippi Sound, through the Rigolets and across Lake Pontchartrain to docks at

the western end of the lake to the rear of New Orleans, or to the two canals that led from the lake into the heart of the city (Irion and Heinrich 1993:19; Pearson and Simmons 1995).

There seems to have been little activity in the immediate vicinity of Breton Island during the Civil War even though a number of Union vessels, most involved with the naval blockade of the Confederacy, were stationed off the Louisiana coast or traveled along it. The first of these was the steam sloop USS *Brooklyn* which arrived off the Pass a l'Outre entrance to the Mississippi River in May 1861 (Winters 1963:47). The *Brooklyn* was soon joined by other vessels, however, most of these ships were concentrated off the mouth of the Mississippi River or farther east near Ship Island and Mississippi Sound where they could intercept blockade runners and Confederate naval vessels (Pearson and Saltus 1996:115-116). Southern vessels trying to run the blockade may have used Breton Sound as a departing point or as a refuge from Federal forces, although the shallow waters of the sound would have prohibited access to any but the smallest boats. Union records do mention a few actions with blockade runners in the vicinity of the Chandeleur Islands. For example, on September 14, 1863, Lieutenant Commander R. Chandler, captain of the USS *San Jacinto*, reported on his ship's capture of the blockade runner *Alabama* which was run aground on "one of the shoals on the inside of the Chandeleur Islands" (Official Records of the Union and Confederate Navies in the War of the Rebellion 1903:550). This particular event took place near Ship Island at the eastern end of the island chain.

The Union did intend to utilize Breton Island as a staging point for land troops during the campaign to capture New Orleans, but the city fell so quickly that the plan seems never to have been implemented. In March 1862 large numbers of Union troops were gathered at Ship Island in preparation for an assault on New Orleans. The principal attack was to be made up the Mississippi River by a fleet of naval vessels under the command of Flag-Officer David Farragut, Commander of the West Gulf Squadron. Army forces, under the command of Major General Benjamin F. Butler, were to aid and support the naval attack. In this plan, some of the troops were to assemble at or near Breton Island, then land on the coast just northwest of the island from where they would approach Fort St. Philip, one of the forts guarding the lower Mississippi River. On March 30, 1862, Major General Butler, then at Ship Island, wrote Flag-Officer Farragut that he was prepared to "attempt the landing off Isle Breton" and was just waiting for Farragut to give him orders to proceed (Official Records of the Union and Confederate Armies in the War of the Rebellion 1881:706). The Union seems to have never actually landed any forces on Breton Island, however, the Confederate authorities in New Orleans thought that they did. General Mansfield Lovell, Confederate commander in the city, reported on April 12, 1862, that the enemy had 10,000 to 12,000 men at Ship Island and "Isle Breton" preparing to attack Fort St. Philip from the rear, after which they would move upriver to New Orleans (Official Records of the Union and Confederate Armies in the War of the Rebellion 1881:653).

Little mention is made of Breton Island in official reports during the remainder of the Civil War. The island does appear in a December 6, 1864, report by Captain W.T. Fuller who was putting up telegraph lines between New Orleans and Ship Island. While returning to New Orleans via the Mississippi River aboard the steam tug *Blossom*, mechanical troubles forced Fuller's party to briefly stop at "Great Breton Island" for repairs (Official Records of the Union and Confederate Armies in the War of the Rebellion 1892:776). Fuller provides no comments or descriptions of the island, probably meaning it was uninhabited.

One of the few nineteenth century descriptions of the island is provided by Samuel Henry Lockett, a professor of engineering at Louisiana State Seminary, then in Pineville, Louisiana. Lockett initiated a topographical survey of the state in 1869 that included descriptions of many of the principal landforms and features. Lockett wrote that Breton Island was low and crooked, oriented generally northeast to southwest and was about 11 mi long.

He, also, noted that there was a good channel between Breton Island and Grand Gosier Islands, which lay 5 mi to the east (Lockett 1969:127).

Vessel traffic into the Mississippi River increased throughout the nineteenth century as New Orleans grew as a port and as navigation conditions on the river were improved. Interests in New Orleans wanted to construct a canal from near the mouth of Mardi Gras Bayou at Fort St. Philip eastward into Breton Sound. This idea had been proposed as early as 1832, but it never was implemented (Irion and Heinrich 1993:21). Instead, efforts were directed by both the state of Louisiana and the Federal government to improve navigation conditions at the mouths of the Mississippi. In 1875, Congress authorized the construction of the Eads Jetties at South Pass, one of the four principal entrances. Completed in 1879, the project gave the South Pass entrance a 35-ft-deep channel (Roberts 1946:274-275). Subsequently, considerable efforts have been expended to maintain this channel as the main shipping entrance into the Mississippi. These various improvements have led to increased traffic into the river and increased traffic in the waters off of Breton Sound. However, most of this is large ship traffic into and out of the Mississippi River which passes a long distance offshore of Breton Island.

Boat activity around Breton Island and all of the Chandeleur Islands increased with the start of Prohibition in 1920 as many vessels operated by "rum runners' traveled the area. Large vessels loaded with alcohol assembled in the waters offshore of the islands beyond the three-mile limit. Most of these ships were under foreign registry, but many were locally owned. These ships would rendezvous with small, fast boats at the islands which would take the illegal alcohol through bayous into Lakes Borgne and Pontchartrain or up the Mississippi River (Irion et al. 1993:22).

Aligned against the rum runners were Coast Guard and custom vessels, most of which were too slow to catch the small boats. They did, however, have some successes. For example, in September 1925, a Coast Guard vessel fired on and sank the power vessel *Emilia G.* in Breton sound off Errol Island (*New Orleans Times-Picayune*, September 1925, in Irion 1993:22). Jackson (1978:277-278) notes that soon after, the rum runners shifted their activities to the west to near Timbalier Light and ran into Barataria Bay and Bayou Lafourche. These activities ended with the lifting of Prohibition in 1925.

Most of the recent vessel activity in the vicinity of Breton Sound has been related to commercial fishing and shrimping, recreational fishing and the oil and gas industry. Drilling for oil and gas began in the waters of western Breton Sound in the 1940s and since then large numbers of crew boats, jack up barges, supply barges, drilling rigs and other types of vessels have traveled past the island visiting the numerous oil and gas platforms and wells located in the vicinity. Many of these vessels use the Baptiste Collete Channel, a maintained channel leading from western Breton Sound to the Mississippi River at Venice, Louisiana. Similarly, large numbers of shrimp boats work in the waters around the island as do larger vessels netting menhaden ("pogy").

In 1956 the United States Congress authorized the construction of the Mississippi River Gulf Outlet (MRGO), which extended from just offshore of Breton Island north to New Orleans, a distance of about 75 mi (Cowdrey 1977). The purpose of the MRGO was to provide a direct water route to New Orleans that was shorter and easier to navigate than was the Mississippi River. The U.S. Army Corps of Engineers began construction on the MRGO in 1961 and it was opened to ship traffic in 1963 (Wicker et al. 1982). The MRGO has been in constant use by ships and barges since opening, however, the relative shallow depth of the channel (36 ft) limits the size of vessels that travel along it; larger ships continue to use the Mississippi River. Additionally, continual silting of the channel of the MRGO has impeded some ship traffic and necessitates periodic maintenance dredging by the Corps of Engineers.

Archaeological Site Potential of the Project Area

The foregoing discussions provide some basis for assessing the potential that archaeological sites exist within the project area. Boat wrecks are of specific concern here. Prehistoric sites once may have existed in this area, specifically associated with landforms related to the St. Bernard Delta Complex (Wiseman et al. 1979). However, as described previously, the upper portions of the St. Bernard Complex has been removed by erosion as landward migration of the shoreface of the complex occurred (Penland et al. 1985). As a result, archaeological deposits that may have been associated with landform features in the upper section of these deltaic deposits (particularly natural levees) have been destroyed. Thus, the prehistoric site potential of the study area is minimal and, even if prehistoric cultural material does exist in situ or as disturbed deposits in the study area, they will be deeply buried.

Historic Shipwreck Site Potential of the Study Area

The navigation history presented above indicates that watercraft of various types have plied the waters of Breton Sound since the arrival of Europeans in the area in the early eighteenth century. Additionally, it is assumed that aboriginal populations traveled the area around Breton Island in dugout canoes prior to and after the arrival of Europeans. The remains of lost dugout canoes are unlikely to be found in the project area given its rather dynamic environment, however they could exist as buried objects on the sandy islands making up the Chandeleur chain, including Breton Island.

The potential for historic shipwrecks occurring in the project area is related to a number of factors, particularly the intensity of vessel use of the area and the nature of the area's natural and manmade hazards which might lead to vessel loss. These hazards include shoals, reefs, barrier islands, pilings, previous wrecks, etc. In addition, natural phenomena that may or may not constitute hazards, such as winds, waves, currents, storm tracks and frequency, etc., also, are factors that affect the wreck potential of any given locale (Garrison et al. 1989b; Irion et al. 1993:18). The relationship(s) between vessel traffic routes and these natural and cultural factors can be used to make general assessments about the occurrence and distribution of wrecks and their present condition as archaeological entities (Pearson et al. 1989). As pointed out by Pearson et al. (1989), the present condition of a wreck as an archaeological site is related to the nature of the wrecking incident and to the post-loss natural and cultural conditions that influence the wreck. These factors are briefly discussed below in an effort to elucidate the wreck potential of the project area.

Breton Island is located near historically documented shipping routes, particularly the route used by the French in the eighteenth century leading from settlements along the Mississippi Gulf coast (particularly Biloxi and Mobile) to the mouth of the Mississippi River (Pearson et al. 1989). Sailing vessels, especially smaller ones, commonly traveled this route inside of the Chandeleur Island chain, within the protected waters of Breton Sound, to and from the Main Pass entrance to the Mississippi. As discussed earlier, and as shown in Figure 1-1, the entrance to Main Pass is located only about 8 mi due south of Breton Island. Shoal waters with depths of less than 5 ft occur in the vicinity of Breton Island, as well as elsewhere in the Chandeleur Islands. These shallows would have presented a hazard to vessels traveling in the area; they were particularly dangerous during high winds which could easily drive vessels onto shoals or onto the shores of barrier islands. Larger vessels would have had to travel in the deeper waters on the Gulf side of the Chandeleur Island chain. These vessels, also, were vulnerable to strong winds and storms, particularly those moving from the south and southeast which could drive ships into the shallow waters of the Chandeleurs. However, by sailing on the Gulf side of the island chain, these larger vessels had more sea room to maneuver and avoid the hazards found in the shallows of Breton Sound.

The shallow waters of Breton Sound, then, have generally excluded larger ships from the area and their loss in the vicinity of Breton Island would most typically occur if driven ashore by storms. In fact, it is known that this did happen. For example, in November 1766, the schooner *Le Constance*, carrying cargo salvaged from the wreck of the Spanish ship *Corazón de Jesús y Santa Barbara*, was blown ashore "in the Chandeleurs" and wrecked (Pearson and Hoffman 1995:82). Available records indicate that the vessel was a total loss. Exactly where the wreck occurred is not known, but *Le Constance* was trying to enter the Mississippi River, suggesting the loss could have occurred in the western Chandeleurs, possibly near Breton Island.

Smaller vessels, such as the single masted *traversiers* and *caiches* of the French, and later sailing sloops and luggers, as well as launches and longboats which were both sailed and rowed, are most likely to have frequented the waters of Breton Sound and around Breton Island during the eighteenth and nineteenth centuries and been lost there (Pearson et al. 1989:81-85). In more recent times, pleasure boats of all types; motorized luggers and trawlers used in fishing and shrimping; as well as oil field supply and crew boats, work boats, and barges have frequented the area. One attraction to small craft in the immediate vicinity of Breton Island is the relatively deep tidal channel that separates Breton and Grand Gosier islands and connects Breton Sound with the Gulf of Mexico. This natural pass, now occupied by the MRGO, was certainly used by vessels in the past, just as it is used today.

Irion et al. (1993:19-21) have summarized the natural phenomena which are likely to have contributed to vessel loss in the Breton Island area as well as the natural processes that affect wreck preservation. Currents represent one of the factors which would influence wrecks and, ultimately, wreck locations and dispersions. The principal current systems in the Gulf of Mexico are controlled by the clockwise circulating Loop Current and its associated counterclockwise flowing eddy currents (Garrison et al. 1989b). One of these eddy currents flows westward along the eastern Louisiana coast, generally following the offshore edge of the Chandeleur Island chain until it reaches the modern Mississippi River Delta, where it turns eastward again. The exact influence this current may have had on any specific shipwreck is unknown, but it could carry disabled vessels generally to the west in the area just offshore of the Chandeleur Islands and may result in a roughly westward dispersion of materials at individual wreck sites. While this west-flowing current might have had a general influence on some shipwrecks, local currents related to tidal flow also would have had an impact on shipwrecks, plus wind patterns are likely to have had an even greater influence on the occurrence and distribution of wrecks.

The major wind patterns in the Breton Sound area are seasonal. Winds typically blow from the southwest during the summer, shifting to the northeast during the winter (Garrison et al. 1989b). The winter pattern is frequently interrupted by southward moving cold fronts known as "northers." Wave heights in the Gulf of Mexico are typically 1-to-1.5-m high, with heights in the study area generally somewhat less than this. Winds and storms, however, can create waves as high as 4.0 m (Garrison et al. 1989b:F11). Increase in wave height can occur very rapidly, particularly during severe squalls which commonly move across the Breton Sound area during the summer.

Severe storms represent another natural factor which influence shipwrecks as well as wreck preservation in the study area. The "northers" that periodically move across the Louisiana Gulf coast during the winter sometimes produce rather severe weather, creating conditions which can be hazardous to vessels. Such a storm may have sunk the *Le Constance* mentioned above. Hurricanes, however, represent the most dangerous of the storms affecting the study area and a number of vessels are known to have been lost on and near the coast of Louisiana during these storms (Pearson et al. 1989).

All of these natural factors influence the occurrence and distribution of shipwrecks in the general vicinity of the study area. A lack of information on specific shipwrecks in the Breton Sound area prevents an accurate assessment of the influence of any specific natural process, but some generalizations can be made. Several of these have been noted in the previous discussions. For example, the shoal water around Breton Island would have represented a hazard to any vessels traveling the area, particularly during periods of severe weather. In light of the prevailing direction of the summer trades, vessels traveling outside of the Chandeleurs, such as between the mouth of the Mississippi River and ports along the eastern Gulf coast, would have faced the possibility of being driven ashore during strong winds or storms if they could not find searoom to escape (Irion et al. 1993:20). Also, "northers" moving across Breton Sound would tend to drive small vessels traveling inside of Breton Island (or the other islands in the chain) onto its northern shore, while summer squalls generally moving to the northeast would push vessels against the southern shore. Boat captains would certainly have tried to avoid these events, but because travel inside of the island, as well as through Breton Island Pass, was desirable and attracted vessels to the area, it must be presumed that some boats have been driven ashore in the Breton Island-Grand Gosier Island area or accidentally lost on shallow bars. Grounded vessels might have been pulled off or completely salvaged, but founderings and losses where salvage was not possible certainly occurred. Irion et al. (1993:20) have argued that all of these conditions "should lead to a relatively high shipwreck density along the entire Chandeleur island chain, including Breton Island." The depiction of several wrecks against the shore of Breton Island and on other shallow bars and islands in the Chandeleurs on modern navigation charts (NOAA 1992) very likely reflect just such losses.

Losses not related to natural causes, also, must be considered. Pearson et al. (1989), using historical documents, present a long list of non-natural causes for shipwrecks within the New Orleans District. These include such things as fire, explosion (particularly on steam vessels), collision, war action and purposeful scuttling. Any of these causes could have contributed to vessel losses in the project area.

Preservation Conditions

A variety of natural forces will have impacted any vessel lost in the project area, some will have been detrimental to preservation and some will have aided preservation. The specific effects of these processes on wrecks in the area are unknown and can only be generalized here. The project area has a generally sandy and moderately hard bottom, such that a sunken vessel is likely to come to rest on the seafloor and remain exposed for some period of time. This is particularly true of vessels sinking in the deeper portions of the project area. In much of the project area, however, the bottom is above the wave base such that vessels resting here will be exposed to disturbance by storm waves. Additionally, the often strong tidal currents flowing through Breton Island Pass could disturb exposed remains (Irion et al. 1993:20). Some strong tidal currents, as well as the strong currents often produced by tropical storms, often tend to scour the sandy bottom of the area. These conditions, also, would tend to disturb exposed shipwreck remains.

All of these current and wave processes would tend to disperse the remains of any given wreck; although the degree of dispersion will vary greatly dependent upon the natural processes themselves and upon the nature and condition of the shipwreck remains. A number of studies of shipwrecks on the Gulf coast in similar high-energy settings have shown that shipwreck remains can remain partially intact even though some materials may be condensed vertically into a single stratum of lag (Irion et al. 1993:20). These include the 1554 Padre Island wrecks in southern Texas (Arnold and Weddle 1974) and the 1766 wreck of the *El Nuevo Constante* off of the coast of Cameron Parish, Louisiana (Pearson and Hoffman 1995), as well as the ballast pile of an unidentified historic wreck located in the northern Chandeleur

Islands (Garrison et al. 1989a). The first two examples have yielded preserved hull remains as well as numerous well-preserved artifacts.

Preservation is enhanced if the shipwreck materials become covered in sand or mud. Burial tends to protect wreckage and artifacts from the physical impacts of waves and currents, it removes wooden items from the damaging effects of shipworms (*Terredinidae*), and it produces a low-oxygen environment that aids in the preservation of organic materials (Pearson et al. 1989). Burial of shipwrecks can occur in the relatively high-energy settings found in the study area, but the scouring effects of currents are likely to prevent burial or at least minimize it.

Recorded Shipwrecks in the Vicinity of the Project Area

The foregoing discussions on the navigation history of the project area, the various hazards to watercraft traveling the area, and the natural process which might influence wreck preservation, all suggest that historic watercraft are likely to have been lost in or near the project area and will exist today as viable archaeological entities. Earlier research tends to support this presumption about the historic boat wreck potential of the Breton Island area. Garrison et al. (1989b) and Pearson et al. (1989) suggest that the potential for shipwrecks in the general Breton Sound area is "moderate," but they provide no specifics on wreck locations, although Pearson et al. (1989) do report that there were four recorded shipwrecks in the Breton Sound area. However, despite these presumptions, the listing of archaeological sites maintained by the Louisiana Division of Archaeology contains no shipwreck sites in or near the project area.

Irion et al. (1993:24) present information on three shipwrecks in Breton Sound derived from information provided by the New Orleans District. These are a gas-screw vessel named the *Fidget* and two unidentified vessels. The *Fidget* foundered in Breton Sound on October 7, 1923, with the loss of four lives. The exact location of the loss of the *Fidget* or the other two vessels is unknown. An examination of information provided in the data base of wrecks and obstructions maintained on the WEB site of the National Ocean Service's Automated Wreck and Obstruction Information System (AWOIS) revealed only one "obstruction" in the near vicinity of the present project area. No information is provided on this obstruction other than its location: Latitude 29° 28' 30" N; Longitude 89° 09' W. This position is outside of and to the west of the project area and corresponds to a possible wreck location shown on the most recent NOAA navigation chart for the area (NOAA chart no. 11363, corrected to December 5, 1992). This possible wreck is identified on the chart as "Wreckage rep PA," meaning "Wreckage reported, position approximate." This possible wreck location is located 1.37 mi southeast of Breton Island and 0.8 mi west of the western boundary of the survey area as shown in Figure 2-4.

The 1992 NOAA navigation chart does show several shipwrecks near the project area and one unidentified obstruction within the project area. One wreck is located immediately adjacent to the eastern edge of Area 2, near its northern end. This wreck is depicted on the NOAA chart by the standard symbol for a submerged wreck with the identifier "Mast" (Figure 2-4). This means that when the wreck was reported to or recorded by NOAA that a mast or other similar feature from the wreck was visible. As is discussed in the following chapter, no identifiable wreck remains were recorded at this location during the remote-sensing survey, however, what is thought to be a pipeline does extend west, northwest from near this identified wreck location to a well head located near the center of Area 2 at latitude 29° 31' 42.19" N, and longitude 89° 11' 57.47" W. This well head is Kerr-McGee Well No. 1, and is the only oil/gas platform situated within the project area, although several platforms are located just outside of the area as shown in Figure 2-4. Why the Kerr-McGee Well No. 1 is not depicted on the 1992 NOAA chart is unknown.

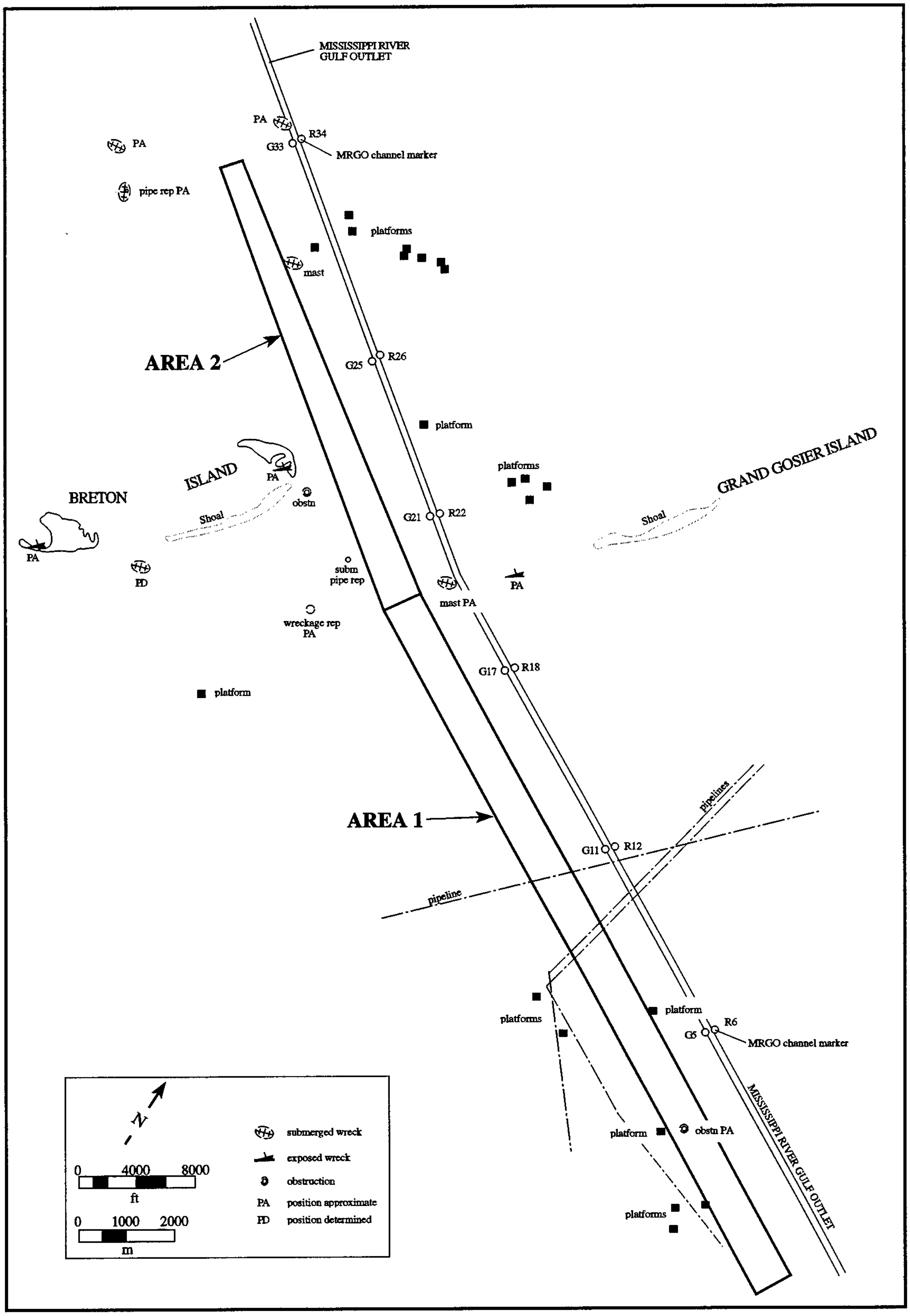


Figure 2-4. The locations of shipwrecks, obstructions, pipelines and oil platforms near the project area derived from 1992 NOAA navigation chart.

The unidentified obstruction shown on the NOAA chart is located in the southern portion (Area 1) of the project area and is identified on the map as "Obstn, PA," meaning "obstruction, Position Approximate." The location of this obstruction is latitude 29° 25' 36" N and longitude 89° 1' 30" W. The identity of this obstruction is unknown and no features which could be associated with it were recorded during the remote-sensing survey.

The 1992 NOAA chart does show several other wreck locations in the vicinity of the project area and Breton Island (see Figure 2-4). The symbol for an exposed wreck is shown at the extreme southwestern end of Breton Island with the notation "PA," meaning Position Approximate. A submerged wreck is shown on the south side of Breton Island between the two exposed segments of the island. The notation "PD" is given with this wreck, meaning "Position Determined" (NOAA 1992). This wreck symbol is located at latitude 29° 28' 56" N and longitude 89° 11' 12" W. Another exposed wreck symbol with the notation "PA" is shown at the eastern end of Breton Island, apparently resting on the northern or inland shore of the island (see Figure 2-4). The existence of these two exposed wrecks was confirmed by James Harris, manager of the Breton Islands Unit of the Southeast Louisiana Refuges, U.S. Fish and Wildlife Service (James Harris, personal communication 1999). The specific identity of these wrecks could not be determined, however, one may be the remains of a vessel known as the *Red Horn*. This information was supplied by Mr. Evan Williams, a life-long resident of Venice, Louisiana, now in his 70s who has spent his entire life working on vessels in Breton Sound, in the Gulf of Mexico and on the Mississippi River. Mr. Williams stated that the *Red Horn* was a "steel deck lugger" about 40 ft long that sank on the "north shore of Breton Island" about 25 to 30 years ago (Evan Williams, personal communication 1999). This was the only wreck that Mr. Williams could remember in the vicinity of Breton Island and he stated that the remains were visible for several years after the sinking. Neither of the wrecks shown on the NOAA chart are on the "north shore" of Breton Island, but erosion along the southern shore of the island and their general northward migration may have been sufficient to now place the wreck on the southern side of the island. No other information on the *Red Horn* has been obtained, however, the February 11, 1958, issue of the newspaper the *New Orleans States Item* reported on the rescue of two men from a "trawler" sinking off of Breton Island. Neither the identity of the trawler nor the exact location of its sinking are known, but considering the date of the loss it may have been the *Red Horn*.

Other wrecks shown on the 1992 NOAA navigation chart include a submerged wreck with an exposed mast just east of the project area where Areas 1 and 2 join and an exposed wreck slightly farther to the east (see Figure 2-4). This latter wreck may have gone aground on the shoals associated with Grand Gosier Island. Three other submerged wrecks are shown just north of the project area; one of which is located in or immediately adjacent to the channel of the MRGO (see Figure 2-4). The identity of none these wrecks is known but most are likely to be the remains of modern fishing vessels (e.g., shrimp boats), pleasure craft, or oil field vessels.

On January 7, 1952, the *New Orleans Times Picayune* reported that a person named Ruth Haggart had been killed in an airplane crash "off Breton Island." Exactly where this crash occurred is unknown, but it might have been near or within the present project area. It is possible that one of the submerged wrecks or obstructions shown on the 1992 NOAA chart represent the remains of this crashed airplane, but this cannot be proven.

CHAPTER 3

REMOTE-SENSING SURVEY

Previous Archaeological Research

Few cultural resources studies have been undertaken in the general vicinity of the project area. Terrestrial and riverine surveys have been conducted along the Mississippi River, located several miles west of the project area, and several studies have been conducted in the St. Bernard marshes located well to the north and northeast of the project area. Two remote-sensing, cultural resources studies have been performed in the immediate Breton Island area and, in fact, a small portion of the area examined by these two studies falls within the present project area. The New Orleans District sponsored the two studies, both of which were conducted by R. Christopher Goodwin & Associates (Irion et al. 1993; Irion and Heinrich 1993). The first of these, conducted in 1992, was a remote-sensing survey of the Breton Sound Disposal Area, a 1600-acre-area located immediately east of Breton Island and between the island and the MRGO (Irion et al. 1993). As shown in Figure 3-1, the northeastern corner of the area examined by Goodwin & Associates falls within Area 2 of the present project area. The Goodwin survey, which utilized magnetometer, side-scan sonar and fathometer, recorded a total of 78 magnetic anomalies (Irion et al. 1993:Table 1). Five "clusters" of magnetic anomalies were recommended for further examination. The selection of targets for evaluation considered a variety of criteria, including magnetic intensity, differential amplitudes, anomaly size, etc. (Irion and Heinrich 1993:24). It should be noted that none of these selected targets falls within Area 2 of the present project area. The second study conducted in the area consisted of the physical examination of the targets selected as potential cultural resources during the remote-sensing survey (Irion and Heinrich 1993:27). Ultimately, four of the five targets recommended for examination were actually evaluated by diving. Target examination involved a straight-forward methodology; magnetic targets were relocated using a magnetometer or gradiometer, the magnetic focus or center of the anomalies were buoyed and then divers were placed into the water to physically examine the bottom at the target area. Divers first examined the bottom for exposed features or objects and then probed the area with a 2.84-m-long probe. Finally, excavations were conducted using a 4-in-diameter induction dredge (Irion and Heinrich 1993:37). No watercraft remains or other cultural debris were found at any of the targets. Irion and Heinrich argue that the magnetics at the targets examined were produced by the remnant magnetism of carbonate-cemented sandstone nodules found at each of the locations examined. They contend that the magnetism of the cemented sandstone most likely was produced by "plumes of methane or natural gas seeping from the underlying sediment" which deposit "magnetic minerals, such as magnetic [magnetite?] and phyrrhotite" during the formation of the nodules (Irion and Heinrich 1993:76).

No other cultural resources studies have been conducted in the immediate vicinity of Breton Island, although the project area has been included in overview studies dealing with

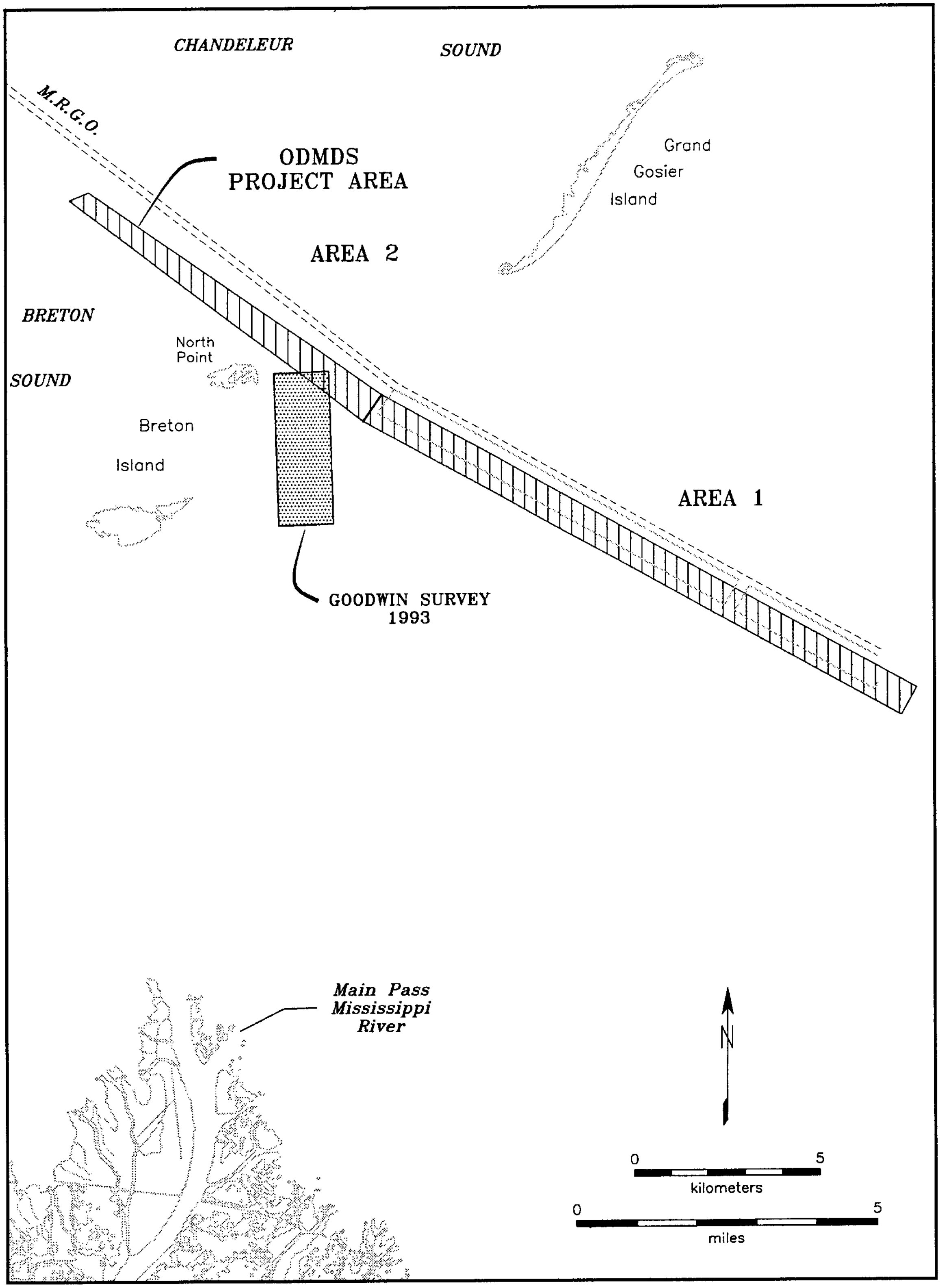


Figure 3-1. The ODMDS Project Area shown in relation to the Breton Sound Disposal Area surveyed by Goodwin & Associates in 1993.

shipwreck probabilities and potentials. The area is included in a broad discussion of the prehistoric and archaeological potentials of the Gulf of Mexico by Coastal Environments, Inc. (1977), although no specific information on the Breton Island area is given. Also, the Breton Sound region is considered by Pearson et al. (1989) in a general study of the history of waterborne commerce and shipwreck potentials within the New Orleans District. Relying principally on documented shipwrecks as well as secondary historical and cartographic sources, Pearson et al. argued that the entire Breton Sound area had a "moderate" probability of containing historic shipwrecks. They found record of only 4 shipwrecks occurring in the western Breton Sound area (Pearson et al. 1989:Figure 5-1), but noted that this number was certainly low and underrepresentative of the numbers of boats actually lost in the area. Garrison et al. (1989b), in a study of shipwreck potentials along the nearshore segment of the Northern Gulf of Mexico, also, argued that the Breton Sound area had a moderate potential for containing wrecks. More recently, Irion et al. (1993:21) have suggested that the wreck potential of the Breton Island area may be somewhat greater than suggested by Garrison et al. (1989b) and Pearson et al. (1989), specifically because the island represents a lee shore along a relatively well traveled, nearshore shipping route.

Other studies that pertain to vessel use and loss in the Breton Sound area include Berman's (1973) compilation of shipwrecks for the coastal waters of the United States and two studies by the Work Projects Administration that present syntheses of data on vessels operating in the region: *Ship Registers and Enrollments of New Orleans, Louisiana*, from 1804 to 1870 (Work Projects Administration [hereafter cited WPA] 1942) and *Wreck Reports: A Record of Casualties to Persons and Vessels On the Mississippi River, Its Tributaries, on Lakes and Other Waterways* (WPA 1938). Neither of these works indicate any vessel losses in the immediate vicinity of Breton Island.

A final study relevant to the present project is the *Louisiana Submerged Cultural Resource Management Plan* prepared by Bruce Terrell (1991). This study formalizes the position and philosophy of the Louisiana Division of Archaeology in regards to submerged cultural resources in the state. The plan presents a brief historical overview of the history of navigation in Louisiana and a synthesis of research conducted on underwater cultural resources to that date. In addition, the plan identifies and prioritizes research objectives and preservation goals seen as important in the treatment of the state's underwater cultural resources.

Survey Procedures and Methodology

Survey Design

The remote-sensing survey of the Ocean Dredged Material Disposal Site (ODMDS) was conducted specifically to locate shipwreck sites. Irion et al (1993:29) have argued that shipwrecks in the Breton Island area are likely to have "been broken up and dispersed by a variety of natural forces, resulting in a scattering of ferrous object." As discussed earlier, however, this may not always be the case. It is very possible that vessels lost in the project area could have come to rest in waters sufficiently deep to protect them from many of the damaging effects of natural processes such as currents and wave action. This would be particularly true of relatively modern vessels, especially those with metal hulls. Further, even if dispersion of shipwreck materials occurred, experience from other shipwrecks in similar settings demonstrates that larger and heavier items (e.g., ballast, hull pieces, iron fittings, cannons, etc.) might be only minimally displaced horizontally even though the vertical stratigraphy of the shipwreck may be considerably compressed. Thus, the remote-sensing survey was designed with the presumption that shipwrecks in the project area could exist either as scattered remains or as relatively intact vessels with minimal dispersal. Data interpretation relied on the same presumption.

The project area extends along the eastern side of Breton Island and measures approximately 16 mi long and 0.5 mi wide and encompasses approximately 5,000 acres along the western side of the MRGO at its southern end (see Figure 1-1). The project area has a slight "dogleg" in it, so for convenience it was divided into two areas. The southern area (Area 1) measures approximately 10 mi long, while the northern area (Area 2) measures 5.9 miles in length. Water depths in the project area range from about 45 ft at its southern end to about 15 ft at the northern end. In addition, several bars and sand banks exist that are as shallow as 12 ft below the surface. The survey area falls within a zone where strong winds and currents and weather-induced high seas are common. Additionally, commercial boat traffic in the form of crew boats, shrimp boats, work barges, etc., make extensive use of the area. As a consequence, close attention was paid to the weather and to boat traffic during field investigations and, as discussed below, weather delays did occur.

The entire 16-mi-long project area was systematically surveyed along transects spaced 100 ft apart and oriented along the long axis of each survey area. Positioning control parts were obtained and digitally stored every 100 ft along survey transects. Coverage of the Area 1, the southern segment, involved 29 transects spaced 100 ft apart and entailed approximately 290 linear mi of survey (see Figure 3-4 below). Area 2, also, contained 29 transects spaced 100 ft apart, however, the eastern edge of this area angles somewhat toward the northwest such that the area is trapezoidal rather than rectangular in shape. The northern area involved approximately 135 linear mi of survey to obtain complete coverage (see Figure 3-11 below). In both areas, survey lines were extended several hundred feet beyond the project boundaries to insure complete coverage. Slight deviations from the survey lanes were required in two instances. In the northern of Area 2 a gas platform (identified as well Kerr-McGee No. 1) blocked several of the preplotted survey lines. In this case, the survey boat was steered around and as close as possible to the platform. At the time of the survey, dredging activities were being conducted within the MRGO and the dredge discharge line extended across the southern end of Area 2, emptying on the northeastern end of Breton Island. The dredge pipe itself was submerged and rested on the bottom, however, several large buoys marking the pipe floated in the survey area. Very slight deviations of course were required to avoid several of these buoys. The total of approximately 425 linear miles of survey was covered at a vessel speed of approximately 4.5 to 5 mi per hour. In addition, several linear miles of additional survey were run over several targets of interest identified during the course of the survey.

The field work was conducted between July 7 and 28, 1999. During this period, a three-person survey crew spent 20 days conducting the survey. Over the course of the project field crew members consisted of Charles Pearson, Dan McDonald, Leroy Mashburn and Tom McDonald. Weather conditions during the study were generally good, although high seas and/or severe thunderstorms prevented work for about 1.5 days. An additional 3 days were expended on travel and mobilization.

Remote-Sensing Equipment

The remote-sensing equipment used consisted of a fathometer, magnetometer and side-scan sonar. Data were collected and stored via an onboard computer using the hydrographic survey software *HyPack*. Precise positioning was obtained with a Trimble differential GPS system. This array of equipment has become a standard package in remote-sensing surveys designed to locate shipwrecks. The survey vessel used was the 24-ft aluminum boat *M/V TBS* with a fully enclosed cabin and powered by two, 150 horsepower outboard motors. The fathometer employed was an Innerspace 448 fathometer operated at 208 kHz cycles per second and an 8 degree beam width. The Innerspace 448 uses a thermal printer to produce real-time hard copies on which time and event marks and coordinate data are automatically printed. During the survey the fathometer data, along with magnetometer and positioning data, were digitally collected and stored on a Zip drive using the navigation program *HyPack*. Although

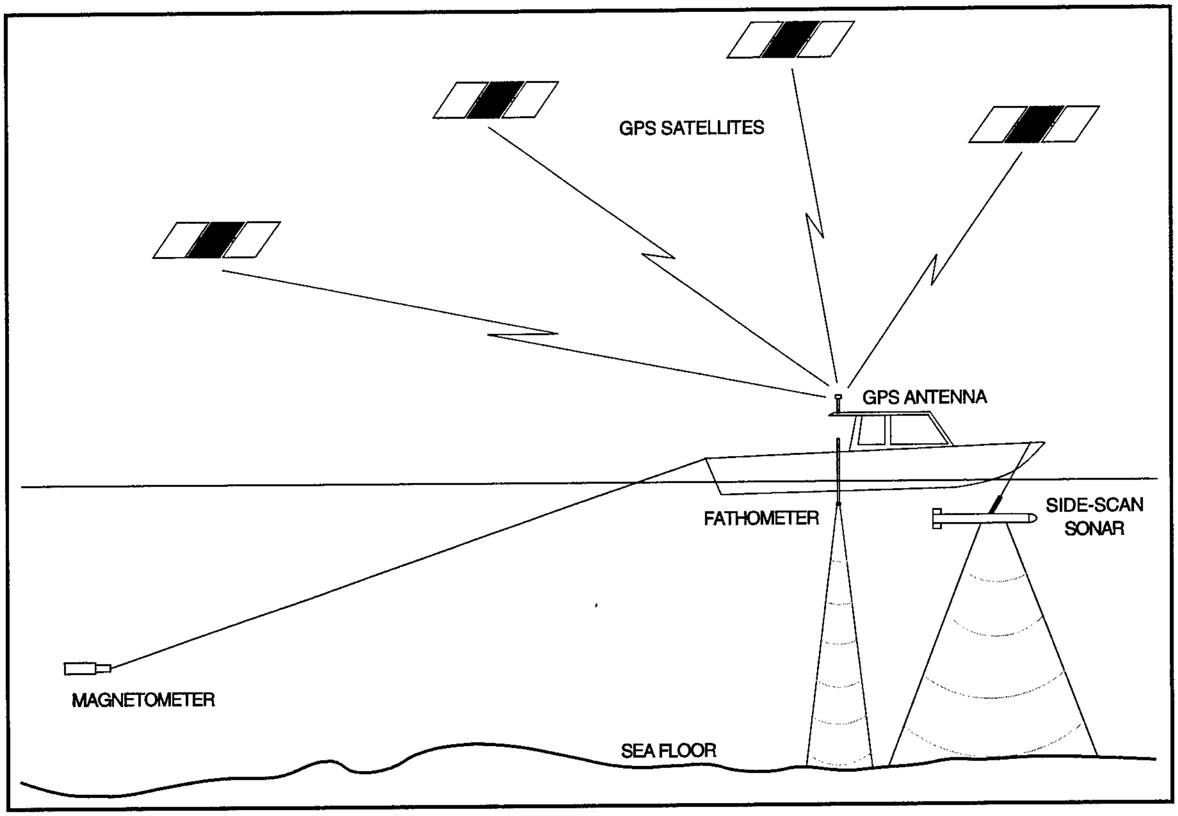


Figure 3-2. Deployment of the remote-sensing equipment during the ODMDS survey.

primarily used to obtain water depths, the fathometer also provides some information on the characteristics of the sea bottom. Generally, the fathometer signal displayed a "hard return" with little subbottom penetration, normally an indication of a hard bottom. During the survey and anchor was dropped overboard to collect a sample of bottom sediment. The sediment collected on the anchor was sand, consistent with the "hard return' seen on the fathometer. In addition, the fathometer was used to collect information on any cultural features that may extend above the seafloor. The fathometer sensor was mounted over the port side of the survey vessel immediately opposite the GPS antenna (Figure 3-2).

The magnetometer used was a Geometrics Model G-806 proton precession marine magnetometer with a strip chart printout recorded on the 100/1000 gamma scale with readings collected every 1 second. The strip chart was continuously monitored during the survey, plus the data were digitally stored onto a Zip drive using *HyPack*. The magnetometer sensor was towed 100 ft behind the survey vessel, beyond the magnetic influence of the boat (see Figure 3-2). The entire distance from the positioning antenna was 115 ft and this offset was considered and adjusted during the production of the computer-derived maps for this study. The sensor was towed at a depth of approximately 5 ft, placing it from 10 to 30 ft or so above the bottom in most of the project area.

The side-scan sonar used was a marine Geo Acoustic sonar using a Model SS941 Transceiver and Model SS942 sonar fish operated at 500 kHz and on a 50-meter scale. Data were displayed on an E.P.C. Model 1086 gray scale printer which was monitored continuously during the survey. Positioning points were automatically printed on the print out. The side-

scan sonar sensor was towed off the starboard bow of the boat at a depth of 3 ft below the surface (see Figure 3-2).

Positioning is of utmost importance in any remote-sensing survey of this type. Accurate positioning is essential during the running of survey lines and for returning to recorded locations for supplemental remote-sensing operations or subsequent underwater investigation of targets. Positioning during the survey was provided by a Trimble Model 4000 DGPS (Differential Global Positioning System) employing a Northstar antenna to collect the differential signal. DGPS systems are now in common use and well known to the archaeological community such that they require little discussion or explanation. The Trimble system, in conjunction with the navigation software program *HyPack*, allows for real-time navigation and data storage with positioning errors on the order of +/- 3 m. The Trimble Model 4000 with the Northstar antenna automatically selects the available differential signal that is most accurate; in the present instance the differential beacon at English Turn was most commonly utilized by the system. Coordinate data were collected using the United States, 1927 North American Datum (NAD 27) and are converted to Louisiana South State Plane (1983) coordinates for use by the Corps of Engineers.

A navigation program produced by Coastal Oceanographic known as *HyPack* was used during the survey. This program provides the capabilities of automatically designing and storing preplotted survey lines which are displayed visually on a computer screen for the boat captain to use for steering. In the present survey, these preplotted lines were spaced 100 ft apart and contained control points every 100 ft. During operation, *Hypack* receives the DGPS positioning information and displays this as the vessel position in relationship to the preplotted survey lines, enabling the boat captain to steer along the planned survey line. *Hypack*, also, is capable of storing collected data from several peripheral instruments in addition to the DGPS, in this instance from the fathometer and magnetometer. The magnetic and fathometer data were downloaded in digital format and stored as numeric data files by *Hypack*. During the collection of data, *HyPack* automatically attaches real-time DGPS coordinates to each magnetometer and fathometer reading, ensuring precise positioning control. During post-processing *HyPack's* positioning files can be used to produce track plot maps and, also, provide the data files containing the X, Y, and Z values needed to produce magnetic and bathymetric contour maps. *HyPack*, itself, contains mapping capabilities, or the data can be utilized by other mapping programs, such as SURFER.

Data Interpretation

Because of the large size of the project area, a tremendous amount of data were collected and stored and subsequently analyzed and processed. For example, in Area 1 (the southern segment of the project area) it took approximately two and one half hours to run each of the almost 10-mi-long survey lines. Thus, on each line in Area 1 approximately 9,000 magnetometer readings were recorded, meaning that approximately 261,000 magnetic readings were collected during the basic survey of Area 1. In Area 2, which is somewhat less than 6 mi long, it normally took just over an hour to run each line, meaning that over 3600 magnetic readings were collected per line. Because not all survey transects extended the entire length of Area 2, approximately 97,000 magnetic readings were collected here. These numbers account only for the basic survey coverage of the project area; a number of additional survey lines were run over several targets identified in Area 1, as shown in Figure 3-4 below. During the entire survey, then, approximately 400,000 magnetic readings were collected and stored. In addition, an approximately similar number of positioning points were collected as well as a smaller number of fathometer readings. As noted, all of these data were stored digitally onto Zip discs and subsequently have been converted into a variety of maps using computer mapping programs, as is discussed in more detail below.

Overall, the data collected during the survey was of very good quality. In a few instances, high waves resulted in a deterioration of the collected data and survey had to be stopped. In some of these cases, an attempt was made to run the survey line in the opposite direction to take advantage of following seas. This sometimes resulted in acceptable data; however, in a few cases the survey had to be stopped entirely until seas subsided.

The side-scan sonar records provided a good picture of the bottom in the project area, indicating a generally flat bottom except in the southern portion of Area 2, where a number of small "hillocks" and rises were noted. These features, also, were recorded on the fathometer. As is discussed below, it is believed that these features represent dredged materials that have been deposited fairly recently and have not yet been dispersed. Also, the side-scan records indicated the presence of current-produced sand waves on the bottom in portions of the project area. In terms of cultural resources, interpretation of side-scan sonar records is fairly straight forward, in the sense that, generally, dense objects (such as metal or wood) are good reflectors and produce a darker image on the record (Fish and Carr 1990). Garrison et al. (1989b:223) note that side-scan sonar images of shipwrecks tend to be geometrically complex, exhibit scouring, and are associated with magnetic anomalies, while isolated pieces of modern debris tend to produce geometrically simple images. Numerous features and objects were identified on the side-scan sonar records. These included numerous drag scars produced by the doors of shrimp nets, as well as drag scars believed to have been produced by the legs of jack-up barges. Most of the discreet objects seen on side-scan records appeared as fairly thin, linear objects of various lengths, almost certainly pieces of metal (iron?) pipe and/or cable. Others are unidentifiable.

Magnetometers are now accepted as critical and standard pieces of equipment in the search for sunken vessels. They have been widely used in marine as well as riverine settings in the New Orleans District, including many settings similar to the present study area. Discussions on the use of magnetometers in archaeological research and the theoretical basis for interpreting magnetic data can be found in Aitken (1958), Breiner (1973), Green (1970), Hall (1966), and Weymouth (1986). Additionally, a number of studies present discussions on the specific application of the magnetometer in the search for shipwrecks and the practical aspects of interpreting magnetic data collected in these studies. Particular efforts have been made at characterizing the types of magnetic signatures created by shipwrecks (e.g., Clausen 1966; Clausen and Arnold 1975; Irion 1986; Irion and Bond 1984; Murphy and Saltus 1981; Watts 1980, 1983).

The magnetometer measures the strength of the earth's magnetic field in increments of nanoTeslas or gammas. A great variety of types of objects produce distortions in this field, generally called "anomalies." Magnetic anomalies produce "signatures" that can be characterized by two nonexclusive factors: strength (intensity) and shape, both of which are dependent upon a variety of factors related to anomaly source characteristics. These characteristics include the composition, size, shape and mass of the source object; its magnetic susceptibility; and its distance from the point of measurement. Magnetic anomalies can be caused by natural as well as man-made features. Anomalies caused by a single-source, ferrous object typically produce a positive-negative anomaly pair known as a dipole. The dipole is usually oriented with the axis of magnetization, with the negative anomaly falling nearest the north pole of the source object. The positive anomaly reading is commonly of greater intensity and area than is the negative.

Although a considerable body of magnetic signature data for shipwrecks is now available, it is impossible to positively associate any specific signature with a shipwreck or any other feature. The variations in the iron content, condition, and distribution of a shipwreck all influence the intensity and configuration of the magnetic signature produced. Also, the manner in which the magnetic data are collected influence the characteristics of the signature. Despite

these problems, shipwreck remains do tend to exhibit characteristic magnetic signatures that often aid in differentiating them from other types of anomalies. Historic shipwrecks, because they generally contain numerous ferrous objects, commonly will produce a magnetic signature composed of a cluster of multiple anomalies (both dipoles [i.e., pairs of magnetic highs and lows] and monopoles [i.e., a single magnetic high or low]), normally with differing amplitudes. Often referred to as a "complex" magnetic signature, this characteristic was recognized in the 1960s by Clausen (1966) and Clausen and Arnold (1975:129) who noted that the wrecks of sailing vessels in Florida and Texas produced magnetic signatures with "a central area of magnetic distortion characterized by a number of intense and generally localized anomalies surrounded. . . [or] interspersed by scattered, smaller magnetic disturbances." Others (e.g., Watts 1980, 1983), however, have demonstrated that a shipwreck can generate much less complex magnetic signatures, sometimes simply a broad-based anomaly of less than 25 gammas. This does occur, but indications are that the distance of the sensor from the source object is a major influence on the complexity of the signature. The farther away the sensor is, the less likely the anomaly will be "complex" because the sensor is reading the wreck as a single large object and does not discern individual and possibly dispersed elements of a wreck.

A study conducted by Garrison et al. (1989b) for the Minerals Management Service attempted to develop an interpretative framework to help discriminate between the magnetic signature characteristics of modern debris and those of historic shipwrecks. They argue that the relationship of magnetic signatures and spatial distribution is at the core of distinguishing the magnetic signatures of shipwrecks from ferromagnetic debris (Garrison et al. 1989b:214). One of the characteristics of shipwreck anomalies noted by Garrison et al. (1989b:222-223) is that a typical signature will cover an area between 10,000 and 50,000 square meters. However, their estimates are related primarily to larger vessels lost in the Gulf of Mexico, and small classes of vessels, such as ones similar to those that traveled the waters of the project area, are known to produce signatures of a smaller size. Even these smaller vessels, however, are likely produce a characteristic multiple (i.e., "complex") anomaly signature which will be recorded on more than one survey line, assuming lane spacing of not more than 100 ft or so. Generally, these broad, complex signatures are distinguishable from the individual anomaly signature that is characteristic of modern pieces of debris (barrels, pipes, pieces of cable, etc.). It should be recognized, however, that complexity is partially dependent upon distance from the source as is noted above. A magnetic anomaly recorded when the sensor is close to a shipwreck may exhibit a complex configuration, because individual ferrous objects are detected; however, at a greater distance the signature may resemble a single dipole because the entire wreck is being recorded as a single-source object.

As noted, the multiple magnetic anomalies of shipwrecks tend to exhibit differential amplitude, reflecting the variability in size, composition, and mass of the elements of the shipwreck. Some non-shipwreck objects, such as a long length of cable, may produce a multiple anomaly signature covering a fairly large area, but the anomalies will customarily show a uniformity of amplitude, distinct from the variability seen in shipwreck signatures (Garrison et al. 1989b:122).

In general, the magnetic signatures of watercraft of modest to large size will range from moderate to high intensity (greater than 50 gammas) when the sensor is at a distance of 20 ft or so. Additionally, wrecks of these moderate-sized vessels tend to produce signatures that are greater than 80 or 90 ft across the smallest dimension. While recognizing that a considerable amount of variability does occur, this information establishes a beginning point for the identification of the sources of the magnetic anomalies in the study area. Additionally, it must be remembered that very small boats, or those containing little ferrous material, such as the small folk craft commonly used on the inland waters of Louisiana, may not be detected by a magnetometer when survey line spacing is on the order of 100 ft, such as used in this survey.

Evaluation of the remote-sensing data relative to their potential for representing a possible shipwreck, relied on a variety of factors including target characteristics (i.e., side-scan image type, magnetic anomaly gamma strength and duration), association with other side-scan or magnetic targets on the same or adjacent lines, and relationship to observable target sources (i.e., channel buoys) which were noted on the magnetometer and side-scan records.

In the present study, magnetic anomalies were evaluated on the basis of amplitude or gamma strength in concert with duration or spatial extent and overall signature configuration. Apart from the obvious features, such as pipelines and well sites which produced anomalies with strong magnetic signatures of appreciable duration, the majority of anomalies recorded in the ODMDS project area were characterized by low gamma signatures (less than 20 or 30 gammas) of very short duration. Most of these anomalies tended to be simple dipoles, consisting of a magnetic high and a low. Examples of typical magnetic anomalies recorded are shown in Figure 3-3. Figure 3-3a shows a typical low amplitude anomaly, a great many of which were recorded in the study area. Indicative of small, single source objects, these anomalies are presumed to represent isolated pieces of debris and were not afforded further evaluation unless associated with a "cluster" or group of similar anomalies on the same or adjacent survey lines. Figure 3-3b shows the magnetic signature produced by the 24-in TET pipeline crossing Area 1.

Except for a few of the possible dredged material “humps” recorded in the lower portion of Area 2, water depths in the project area ranged from about 15 to 45 ft, but most commonly on the order of 20 to 25 ft. With survey lines spaced 100 ft apart and with the magnetometer sensor about 5 ft below the water surface, objects lying on or near the bottom would have been from as near as 7 ft to as far as about 65 ft in the extreme southern part of Area 1 where waters were deepest (This assumes a maximum water depth of 45 ft and a maximum horizontal distance of 50 ft to an object lying on the bottom.) However, in most of the area surveyed, the sensor would have been much less than 50 ft away from any object lying on the sea bottom. The remains of an average vessel (presuming a vessel containing a reasonable amount of ferrous material) should create a fairly large and obvious magnetic anomaly at these relatively short distances (see Garrison et al. 1989b). In light of this, anomalies that were less than 50 gammas in strength were eliminated from consideration as possible wrecks unless other factors suggested otherwise. These other factors included occurrence of an anomaly on adjacent survey lines and occurrence of a cluster of individual anomalies forming a spatially distinct signature.

Evaluation of the magnetic targets also included correlations with side-scan sonar targets. Because the sonar record gives a visible indication of the target, identification or evaluation of potential significance are based upon target shape, size and configuration, as well as association with magnetic targets. Targets such as isolated sections of cable or chain can normally be immediately discarded as nonsignificant, while large areas of above-sediment wreckage are commonly easily identifiable.

Examination of Oil and Gas Pipelines

The project area extends across several 3-mi-square lease blocks located in what is designated as the “Breton Sound Area” in terms of oil and gas mineral leases. The northern end of the project area falls in the southwestern corner of lease block 29 and it extends southeastward across lease blocks 36, 37, 44, 43, 42, 55 and ends in the western half of lease block 56. Development of this area by the petroleum industry began in the late 1940s and today large numbers of oil and gas pipelines criss-cross the area and accurate interpretation of remote-sensing data requires that their locations be identified. Several maps were examined to obtain information on pipelines lines in the project area. The 1994 Transco Energy Company

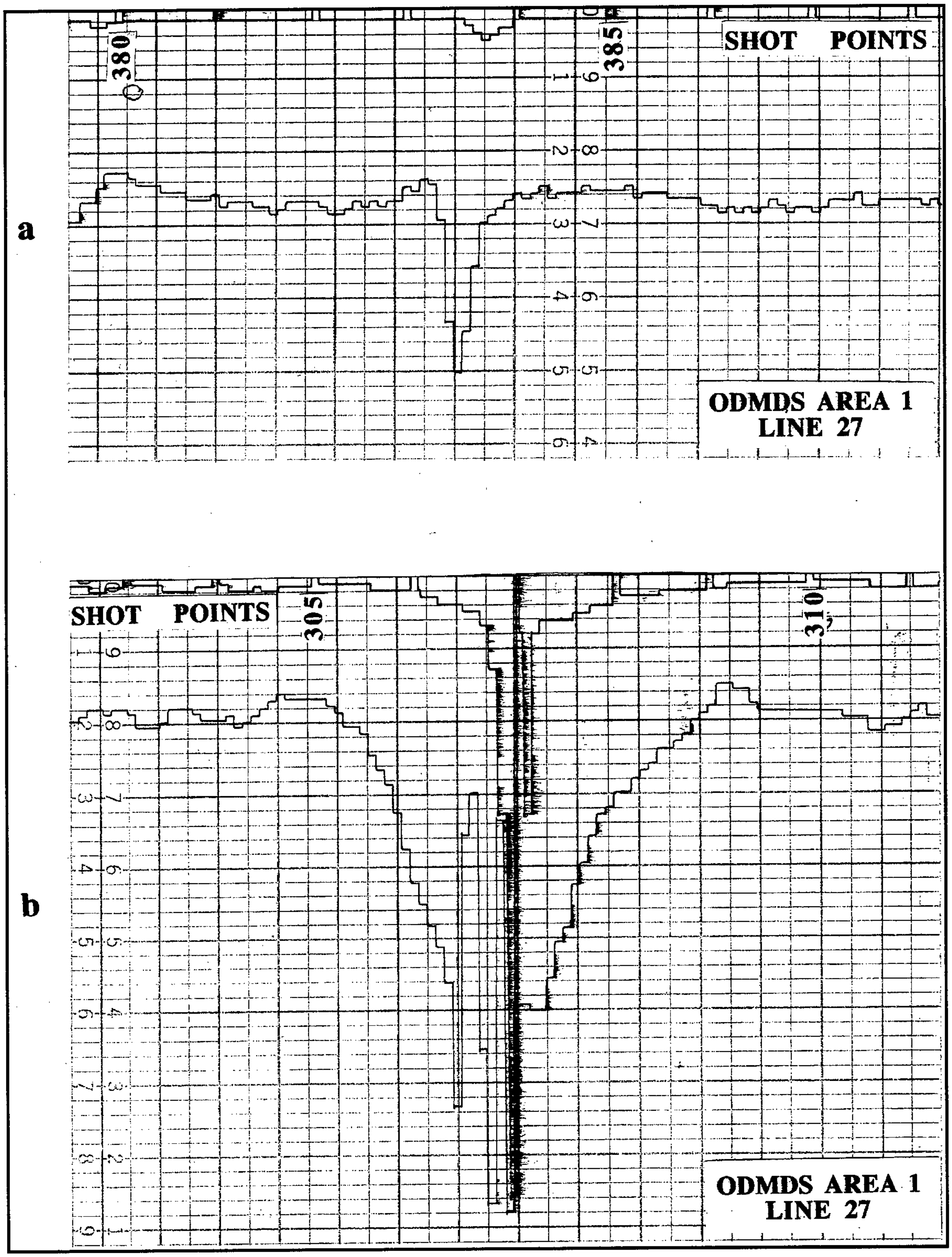


Figure 3-3. a) magnetic anomaly of low amplitude (26 gammas) and short duration typical of that produced by individual pieces of ferrous debris; b) intense magnetic anomaly produced by the 24-in TET pipeline crossing Area 1.

Map of South Louisiana and Central Gulf of Mexico Showing Natural Gas Pipe Lines shows several pipelines crossing the project area. Two pipeline routes cross Area 1; a 24-in TET pipeline running roughly northeast-southwest across the southeastern quarter of lease block 43 and a pair of smaller diameter lines (12-in- and 16-in-diameter) named "Chandeleur P/L" starting at a collection well just southwest of the lower end of Area 1 and running roughly north-south across the extreme eastern edge of lease blocks 43.

Three pipelines are shown crossing Area 2 of the project area. These lines all extend from near Breton Island and run to the northeast crossing the project area in lease block 36. One of these is identified as 14-in-diameter pipeline, the other two are identified as 4-in-diameter lines (Transco Energy Company 1994).

The 1992 NOAA Chart No. 11363 for the area shows the three pipelines crossing Area 1, but it does not show any individual pipelines in Area 2. However, immediately adjacent to the project area, this chart does identify a "Pipeline Area" crossing the channel of the MRGO which seems to encompass the routes of the three pipelines shown crossing Area 2 on the Transco map.

All of these pipelines, plus others not shown on maps, were recorded during the remote-sensing survey. These are discussed in the following sections.

The Results of the Remote-Sensing Survey

The findings of the remote-sensing survey are presented in the following discussions. As noted, because of its large size, the project area was divided into two sections for convenience of survey and in handling the collected data. These two areas are discussed separately below.

Area 1

The southern portion of the project area is designated Area 1. The long axis of this area is oriented approximately northwest-southeast and it measures approximately 10 mi long. As shown in Figure 3-4, a total of 29 survey transects were run along the long axis of Area 1 to achieve complete coverage. In addition, supplementary survey lines were run over several magnetic and side-scan targets identified during the initial coverage.

Figure 3-5 presents a contour map of the bathymetry of Area 1. At the northwestern end of the area water depths are about 25 ft, there is ridge extending across the area just west of the center and than the bottom slopes downward to a depth of about 45 ft at the southern, or offshore, end of the area. This ridge rises to a minimum depth of about 14 ft. This feature seems to be a natural shoal or bar, however, it may have been augmented by the dredged material which has been pumped into this area over the years.

A large number of magnetic anomalies and several side-scan sonar targets were recorded in Area 1. The several maps shown as Figure 3-4 present contoured magnetic data from Area 1. The contour interval is 40 gammas and is produced in AutoCad. The linearity seen in some of the magnetics is related to diurnal fluctuation, a product of the long duration of the survey. Diurnal variation refers to the daily shift in magnetic field strength that occurs over the course of a day. This shift normally varies in the tens of gammas over a given day, but can be considerably more when effected by sunspot activity (Weymouth 1986:346). Diurnal fluctuation can be corrected by several methods; one of the most common is to use a base station to take readings continuously or periodically over the duration of a survey and then using the base station readings to correct diurnal fluctuation obtained during the survey. Another technique is to mathematically manipulate the raw magnetic data to remove or, at least,

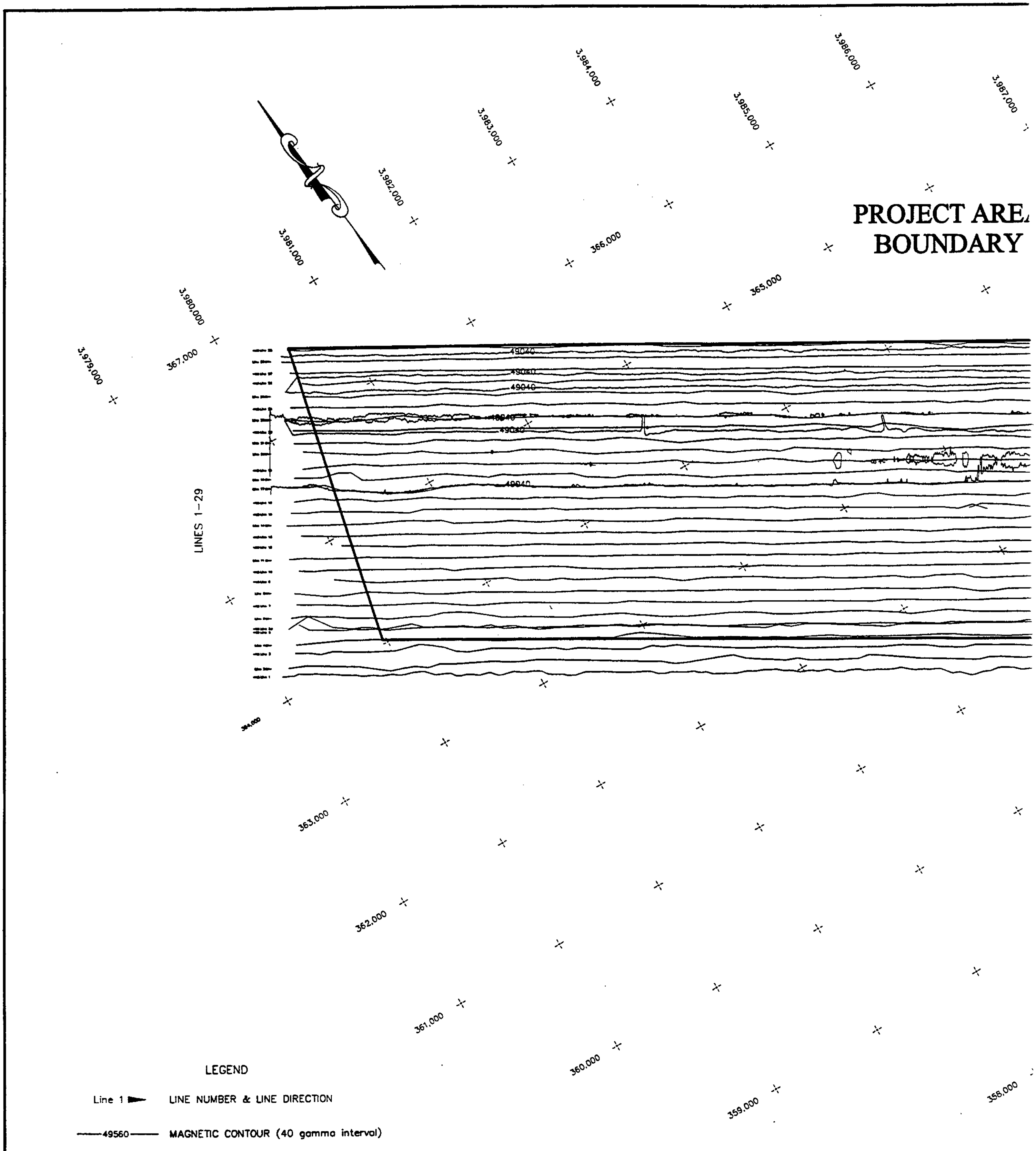
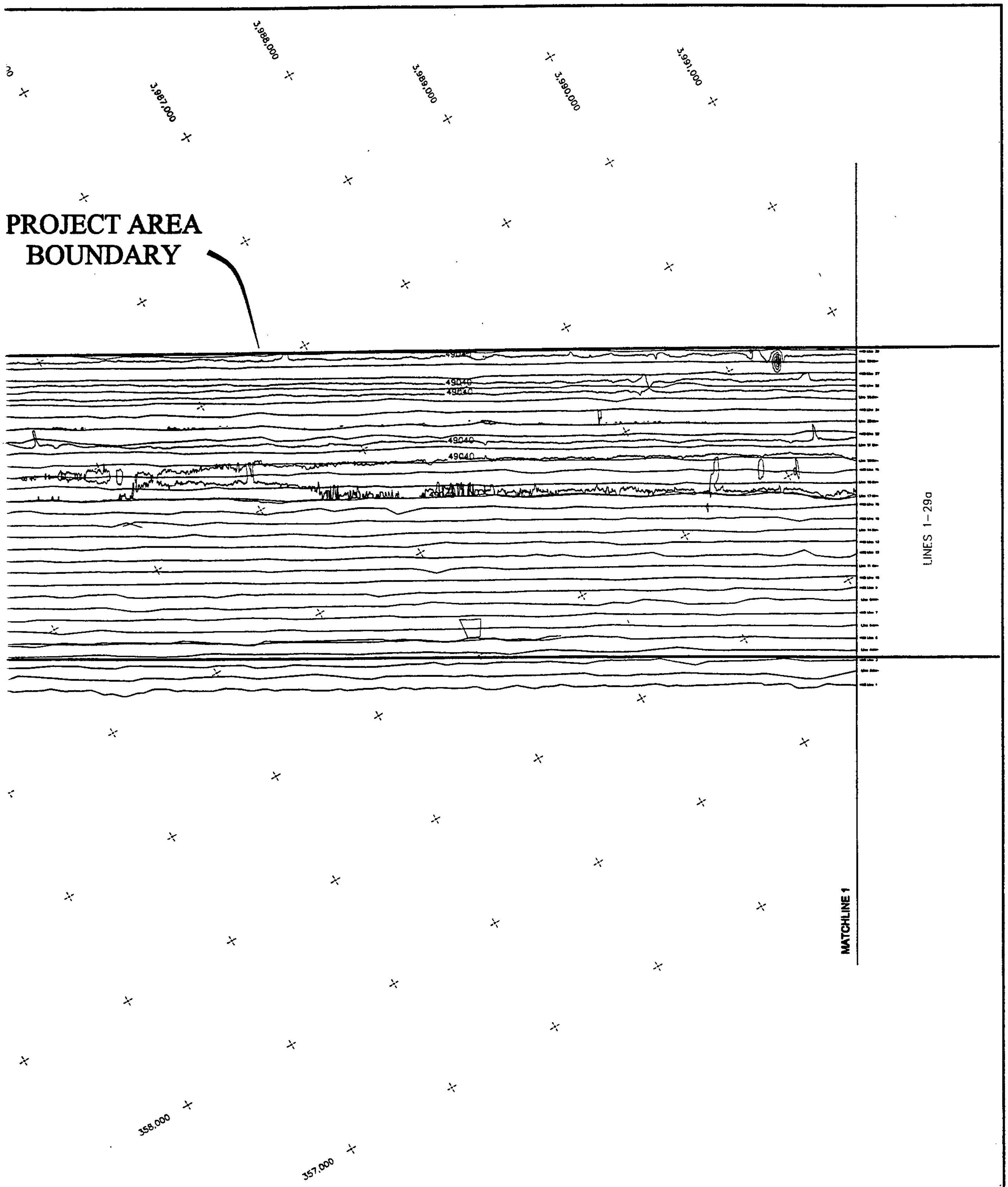


Figure 3-4a. Contoured magnetic data and survey vessel tracks in ODMDS Area 1. Contour interval = 40 gammas.

(1)



3,987,000
3,988,000
3,989,000
3,990,000
3,991,000
PROJECT AREA
BOUNDARY
49040
LINES 1-29a
MATCHLINE 1
358,000
357,000

mas.

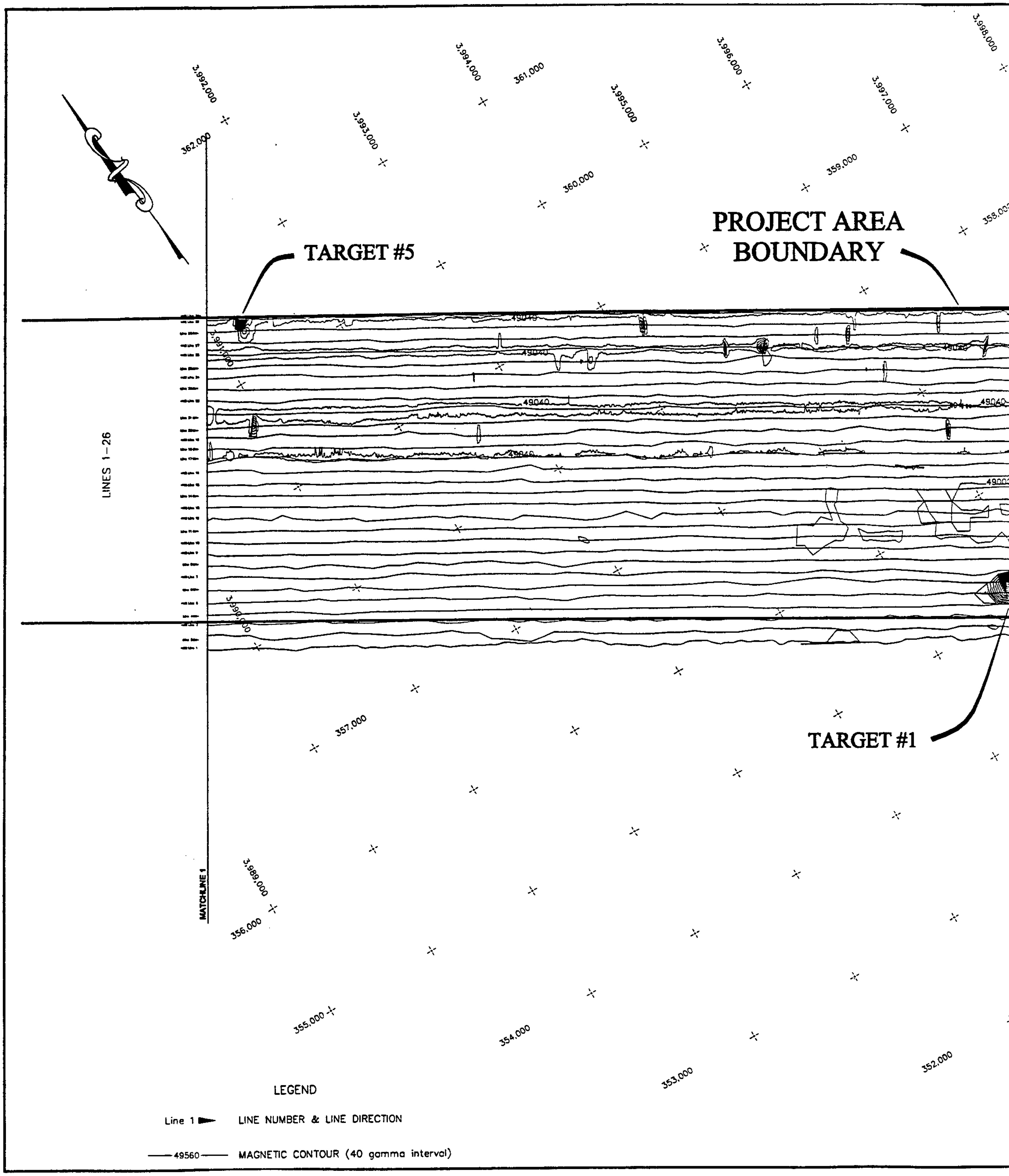
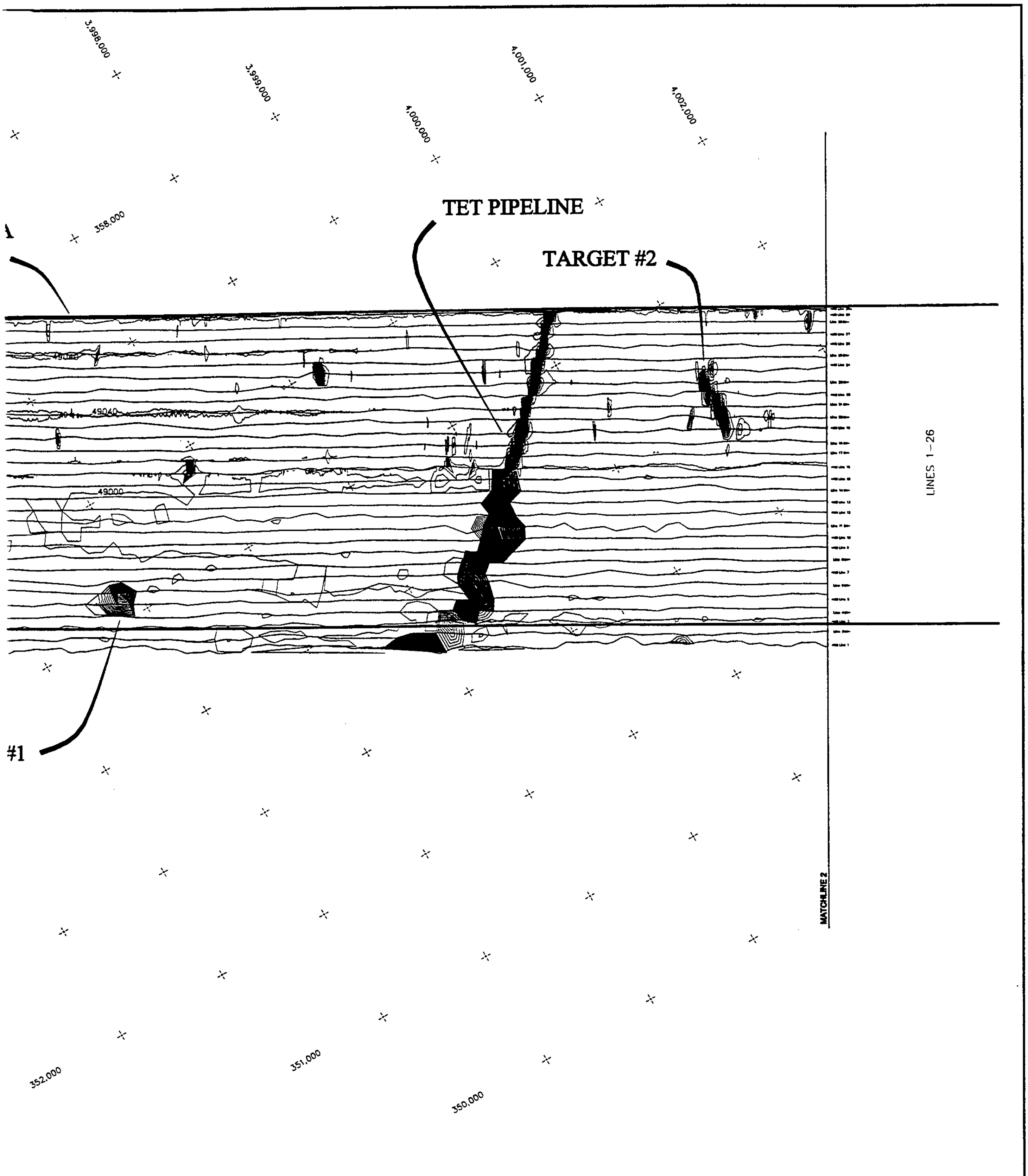


Figure 3-4b. Contoured magnetic data and survey vessel tracks in ODMDS Area 1. Contour interval = 40 gammas.

(1)



TET PIPELINE
TARGET #2
#1
LINES 1-26
MATCHLINE 2
3,998,000
3,999,000
4,000,000
4,001,000
4,002,000
358,000
352,000
351,000
350,000
49040
49000

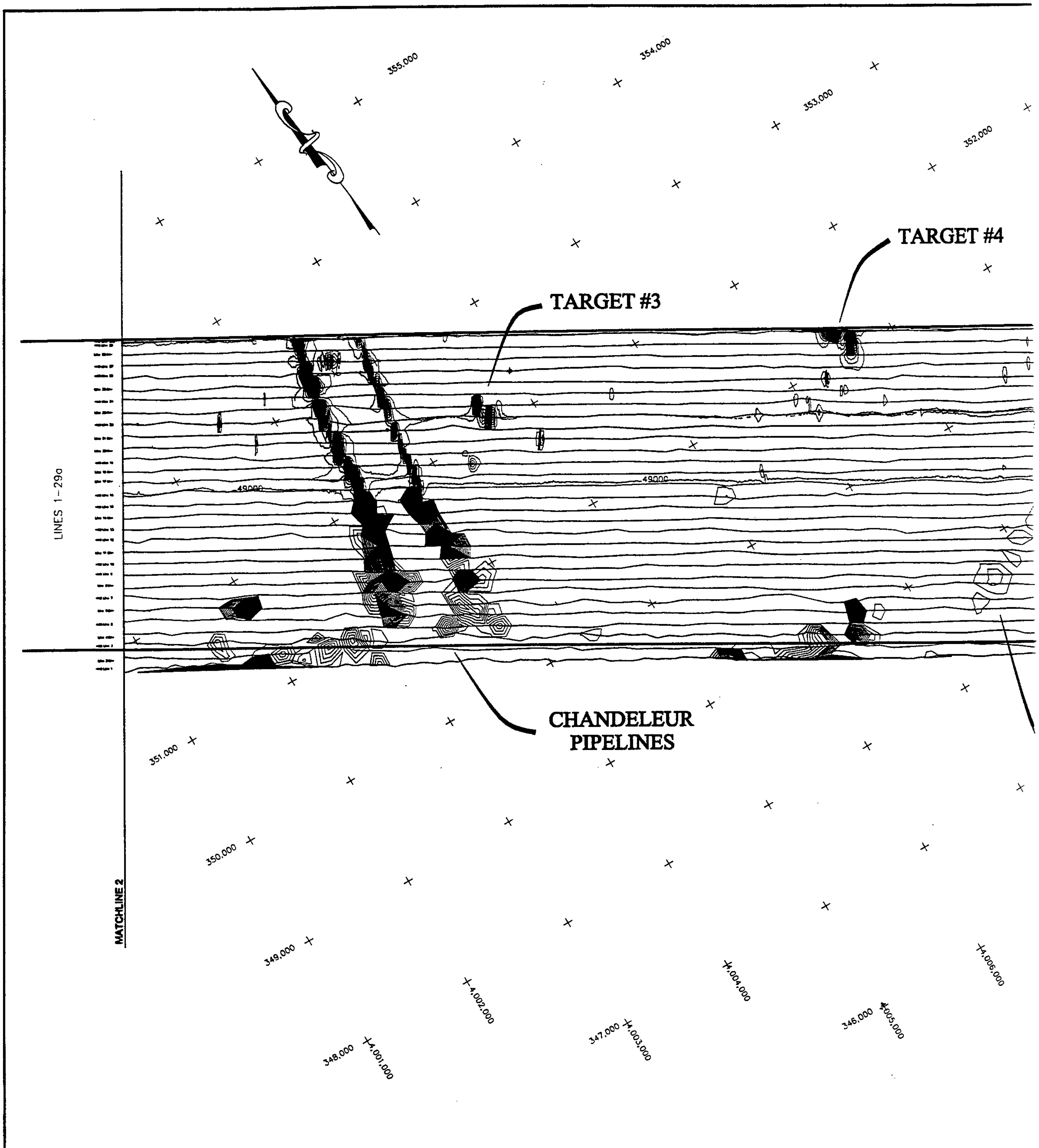
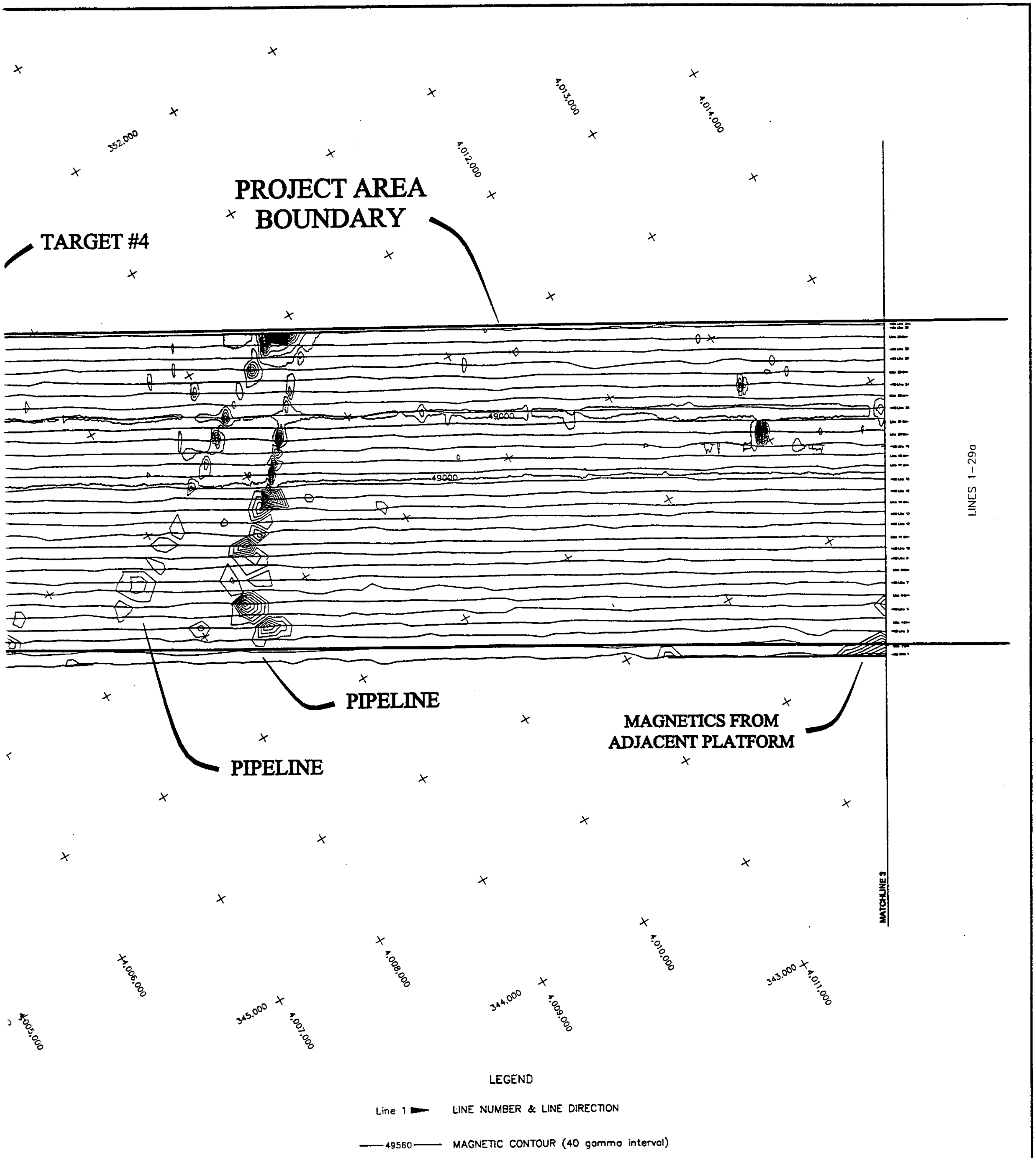


Figure 3-4c. Contoured magnetic data and survey vessel tracks in ODMDS Area 1. Contour interval = 40 gammas.

(1)


PROJECT AREA
BOUNDARY
TARGET #4
PIPELINE
PIPELINE
MAGNETICS FROM
ADJACENT PLATFORM
LINES 1-29a
MATCHLINE 3
352,000
4,012,000
4,013,000
4,014,000
4,005,000
4,006,000
4,007,000
4,008,000
4,009,000
4,010,000
4,011,000
345,000
344,000
343,000
49000
LEGEND
Line 1 LINE NUMBER & LINE DIRECTION
49560 MAGNETIC CONTOUR (40 gamma interval)

ias.

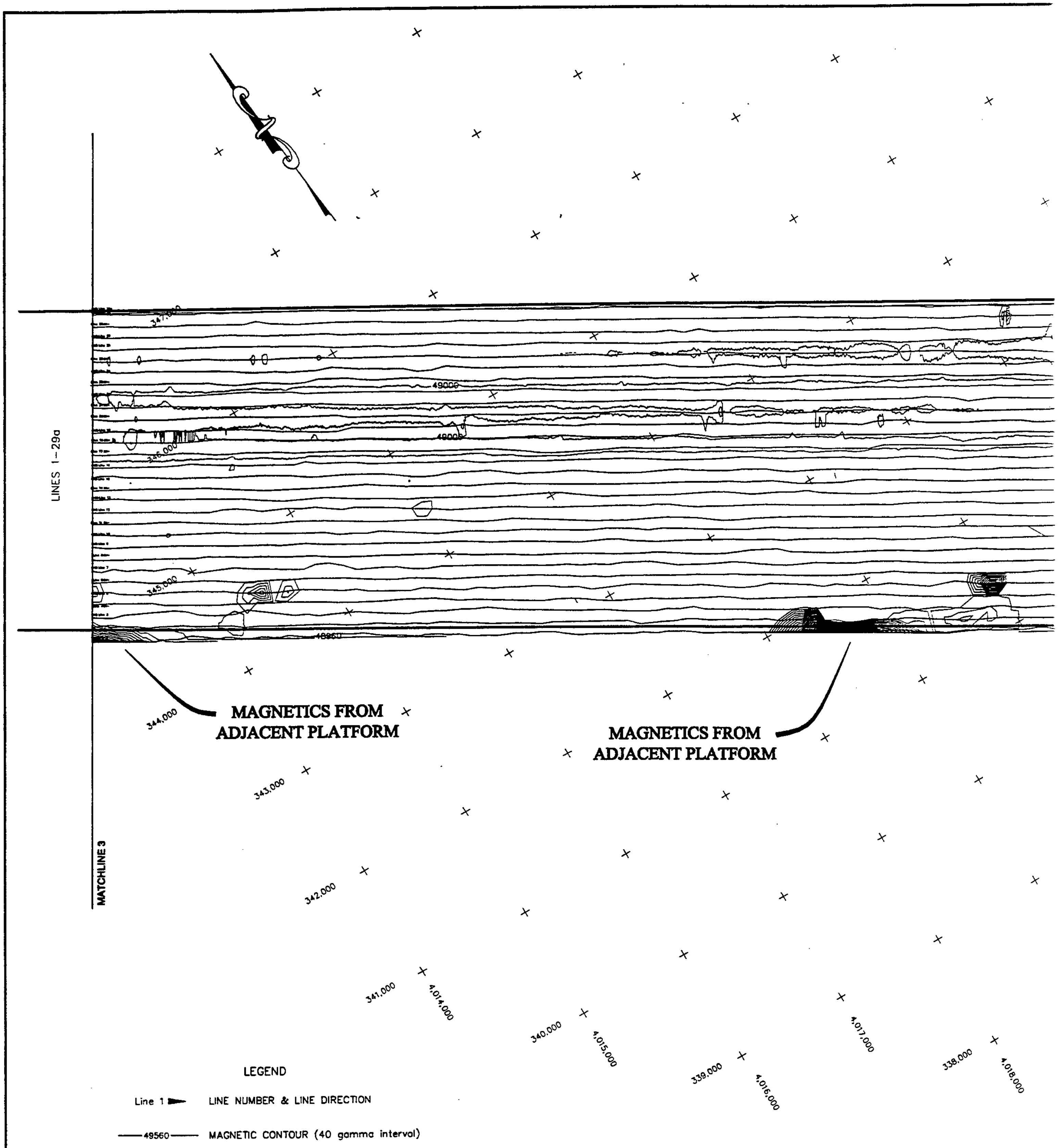
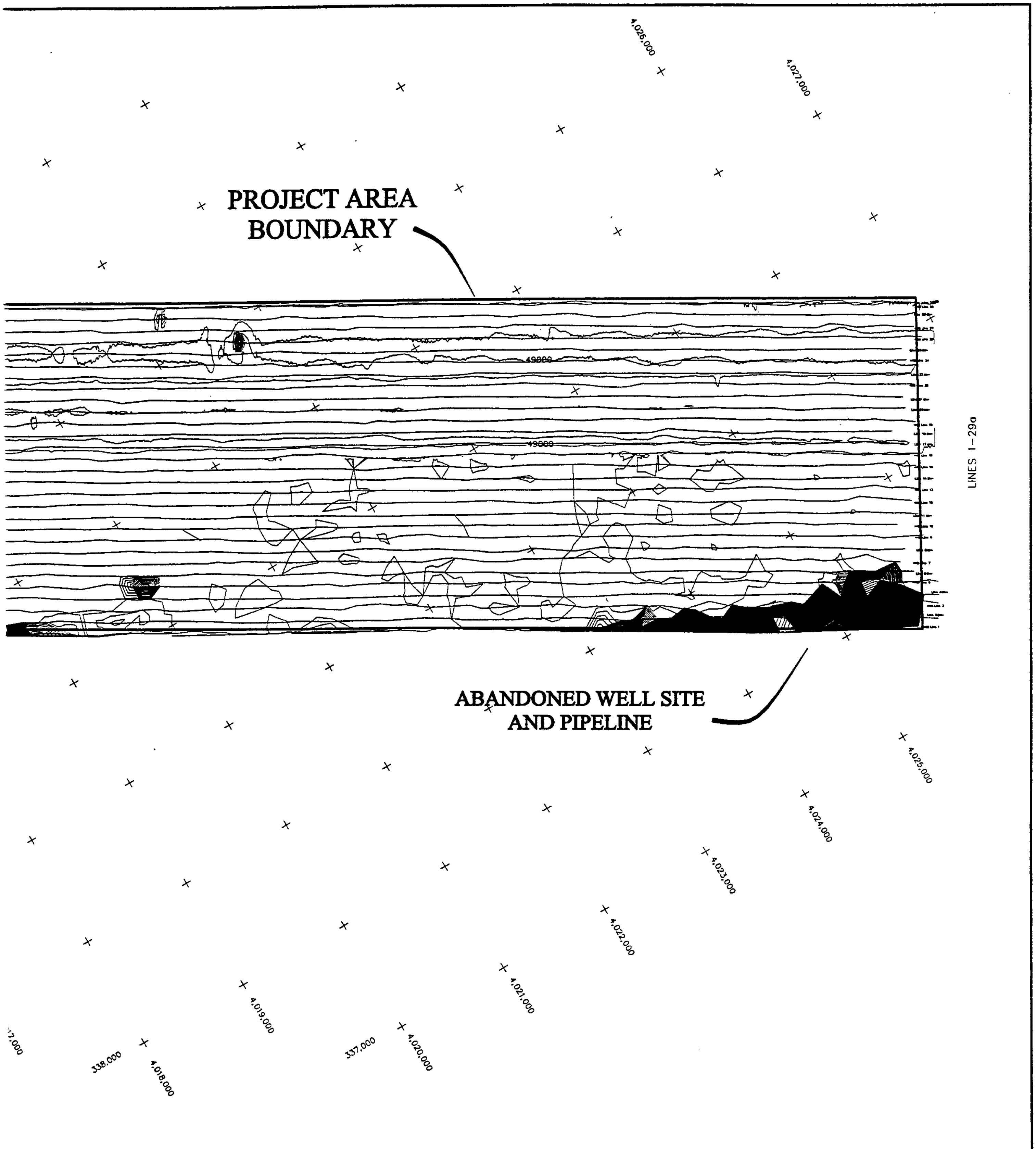


Figure 3-4d. Contoured magnetic data and survey vessel tracks in ODMDS Area 1. Contour interval = 40 gammas.

(1)



4,026,000
4,027,000
PROJECT AREA
BOUNDARY
49000
LINES 1-29a
ABANDONED WELL SITE
AND PIPELINE
4,025,000
4,024,000
4,023,000
4,022,000
4,021,000
4,019,000
4,020,000
337,000
338,000
4,018,000

mas.

(2)

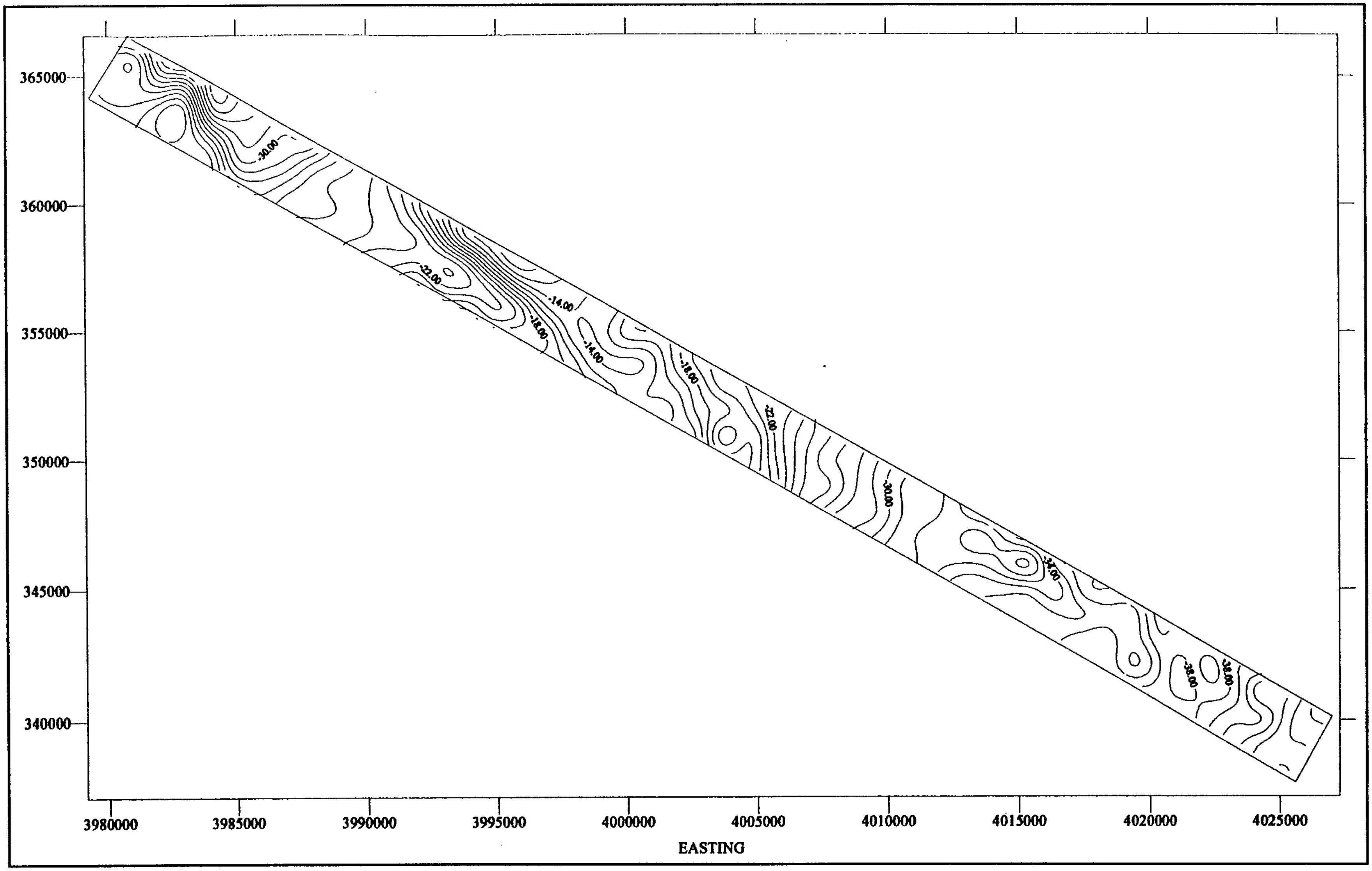


Figure 3-5. Bathymetry in ODMDS Area 1. Contour interval is 1 ft. Grid is state plane coordinates, NAD 1983.

minimize the effects of diurnal fluctuation, usually involving corrections to individual lines or by averaging all of the data in some manner (e.g., adjusting raw data with a "running average"). In the present instance it was determined that the diurnal fluctuation did not adversely effect the interpretation of the magnetic data because the absolute field-strength was not the critical concern. Rather it was the difference among magnetic readings over relatively small areas that was of importance. Given the principal targets of interest in the project area (e.g., historic shipwrecks), it can be assumed that the magnetic gradients produced by these objects will be much more intense over short distances than will diurnal shift and, thus, can be easily distinguished in the contoured data.

As can be seen in Figure 3-4, the most obvious and intense magnetics are related to five pipelines crossing the area and to what is believed to be an abandoned well site and associated pipeline at the extreme southern end of the project area. This possible abandoned well site and pipeline was recorded on the first 9 survey lines in the extreme southwestern corner of Area 1, and produced a magnetic signature covering an area measuring at least 800 ft by 2200 ft, with magnetic intensities of over 1000 gammas. It was apparent that the magnetic signature did extend outside of the project area to the south. No obvious side-scan sonar features were noted at this location. It is believed that this huge magnetic signature is related to the abandoned pipe and well head as well as debris from a former derrick from an abandoned well site; although no information on this well could be located. The lack of record suggests that the site was abandoned many years ago. As shown in Figure 2-4, a pipeline is known to extend toward this corner of the project area and it probably leads to this former well site. In fact, the magnetics recorded on the first two survey lines seem to show this pipeline entering the project area from the west (at state plane coordinates N 338253; E 4025245), however, the intensity of the magnetics from the main portion of the well site somewhat mask what may be the pipeline magnetics.

One of the pipelines crossing Area 1 which is marked by signs is the 24-in TET pipeline crossing near the center of the area (see Figure 3-4b). This pipeline generally produced relatively intense magnetics, on some lines over 1,000 gammas (see Figure 3-3b), plus, on many lines, the pipeline trench appeared as a slight trough in the seafloor on side-scan sonar records. This TET pipeline, also, is depicted on various maps examined, as is the pair of pipelines crossing Area 1 approximately 5,000 ft to the southeast. This pair of pipelines is the 12-in- and 16-in-diameter "Chandeleur P/L" identified on Transco Pipeline maps (Transco Energy Company 1994) and shown in Figure 2-4 above. This pair of pipelines is marked by a sign reading "Gas Pipeline, Chandeleur Pipeline Co." As shown in Figure 3-4c, the magnetic signature of these pipelines was quite obvious, but normally less intense than the signature produced by the larger TET pipeline. Like the TET pipeline, the location of this pair of lines often appeared as a slight trough on side-scan sonar records. Another pair of what may be pipelines was identified crossing Area 1 about 5,000 ft south of the pair of Chandeleur Pipeline Company lines (see Figure 3-4c). The magnetic signature of these lines was generally much less intense than that displayed by the other pipelines. On some lines, these two features produced magnetic gradients of less than 100 gammas. It is believed that these features represent a pair of small-diameter lines connecting well sites that are generally called "flow lines." Considering the low amplitude magnetics of these features, it is possible that they are not pipelines at all, but are cables of some sort. In either event, these features do not appear on various maps of the area nor are they marked by any type of signage.

Two other oil field-related features were recorded by the magnetometer in Area 1 during the survey. These were two platforms located near the western edge of the survey area near its southern end. Both platforms produced discernible magnetics on several westernmost survey lines (see Figure 3-4d). None of the oilfeld-related features discussed here are considered to be significant cultural resources.

Table 3-1. List of Targets of Interest Recorded in the Project Area.

Target Number	Magnetic Type*/ Intensity (gammas)	Anomaly Size (ft)	Side Scan Occurrence	Water Depth (ft)	Location State Plane
Area 1					
1	C/ 2000+ g	250x550	yes	20	N=355250; E=3995920
2	C/ 3600+ g	200x650	no	16	N=354100; E=4001120
3	D/ 2285 g	200x200	no	22	N=352150; E=4004565
4	D/ 800+ g	≤100	no	25	N=351100; E=4007600
5	D/ 350 g	25x125	yes	21	N=360450; E=3991225
Area 2					
6	D/ 2770 g	200x360	no	16	N=382000; E=3957800

* D=dipole; C=complex

As seen in Figure 3-4, a number of isolated magnetic signatures of varying intensities were recorded throughout Area 1. These signatures were recorded on single survey lines and tended to display relatively low or moderate magnetic intensities, such as the example shown as Figure 3-3a. In a few instances, these magnetic signatures were associated with thin, linear objects on side-scan records identified as pieces of pipe, cable or similar debris. It is believed that the sources for this class of magnetic signature and side-scan feature are individual pieces of modern debris, most of which have been accidentally lost or purposefully thrown from commercial and recreational vessels using the area. It is interesting to note that most of these discreet magnetic anomalies are scattered along the eastern one half of Area 1, closest to the MRGO. Assuming that most of the material dredged from the MRGO has been deposited in the eastern half of the disposal area, then it is likely that many of these objects represent pieces of ferrous debris that have been removed from the MRGO during past dredging. As such, most will likely represent debris resulting from commercial vessel activity on the MRGO. These types of objects are not considered to be significant cultural properties.

Targets of Interest

The in-field analysis of the collected data identified 5 targets in Area 1 that were deemed "targets of interest." These targets displayed magnetic or side-scan sonar characteristics similar to those of known shipwrecks. The magnetic criteria for selection of these targets are those mentioned above: 1) a magnetic signature of greater than 50 gammas recorded on more than one survey line (e.g., covering an area greater than 100 ft across), and 2) a "complex" magnetic signature, i.e., one producing multiple highs and lows of differential amplitude. In addition, information derived from side-scan sonar and fathometer records were used to clarify magnetic data where possible. Additional transects were run over these targets to gather supplemental remote-sensing data. Information on these five targets is provided in Table 3-1. As can be seen, some targets were recorded only by the magnetometer, however, several, also, could be correlated with objects seen on side-scan sonar and fathometer records. Each of these targets is discussed below.

Target 1

Target 1 is located toward the western side of Area 1, approximately 3,000 ft northwest of the TET pipeline (see Figure 3-4b). This target was originally recorded as a magnetic anomaly and a side-scan sonar object on survey lines 4, 5 and 6. Additional survey lines run

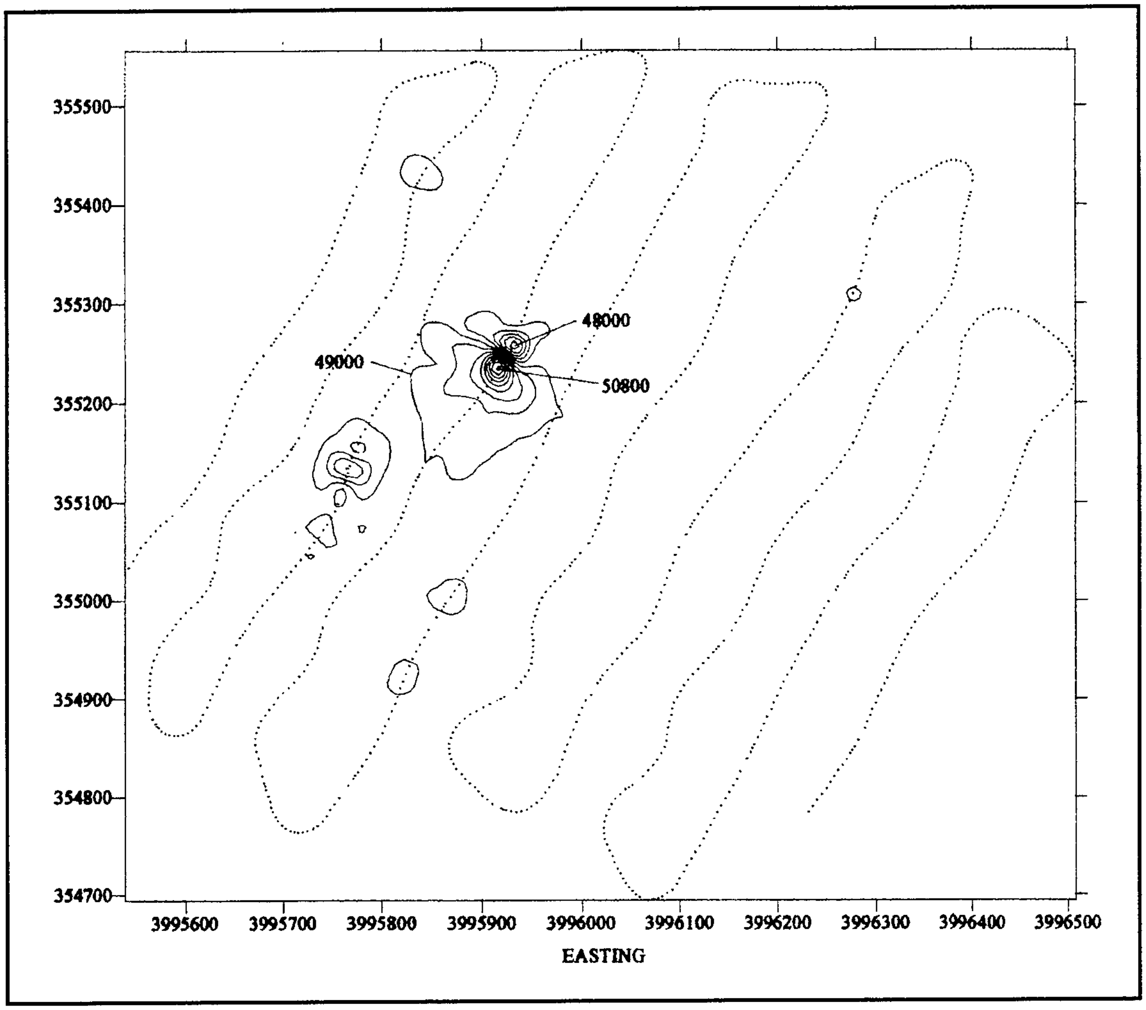


Figure 3-6. Magnetic signature of Target 1, Area 1. Survey vessel track is shown. Contour interval = 200 gammas.

were over the target to more carefully define it and the collected data were contoured with the program SURFER. SURFER, also, was used to contour the magnetic data for all other targets of interest. The data from Target 1 produced a magnetic signature consisting of a principal, fairly intense dipole anomaly and an associated dipole, all covering an area about 250 ft wide by 550 ft long (Figure 3-6). The principal dipole is located at state plane coordinates: N=355,250; E=3,995,920 (NAD 1983, Louisiana South).

The side-scan sonar image at the target consists of two elements; a long, linear object which looks very much like a piece of pipe, plus a "V-shaped" object, both of which project above the sandy bottom in about 20 ft of water (Figure 3-7). In the portion of sonar record shown as Figure 3-7 the sonar sensor is passing directly over the long, linear object, which appears to measure approximately 30 ft long. The V-shaped object is lying approximately 60 ft away from the sonar sensor. This was the only side-scan sonar image in all of the project area which appeared to be something other than a piece of pipe or cable. The magnetic signature of Target 1 does, in some respects, exhibit characteristics of known shipwrecks. The signature covers a fairly large area (137,500 ft^2) and it is "complex" in that it contains multiple highs and

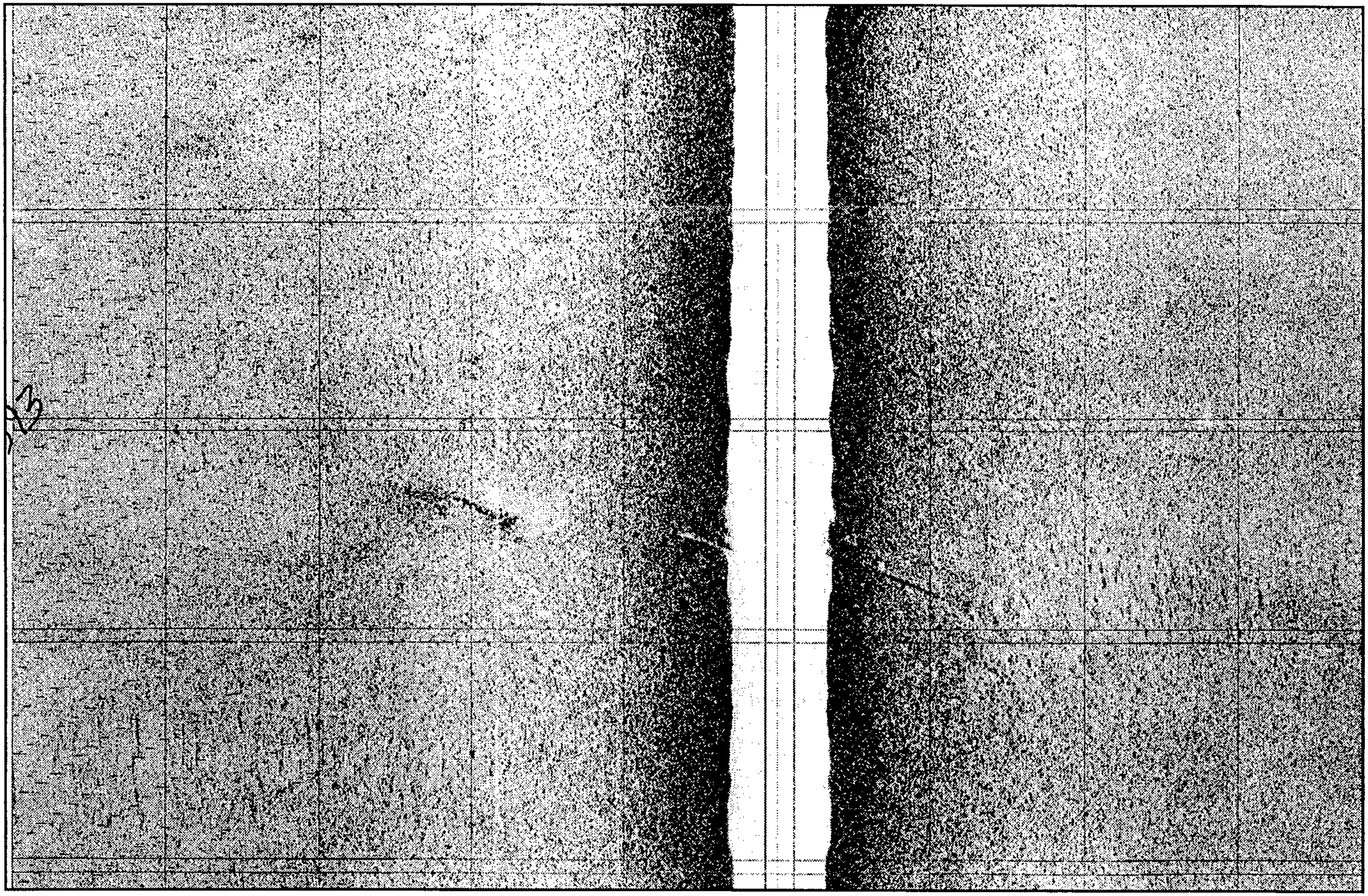


Figure 3-7. Side-scan sonar image of Target 1, Area 1. Horizontal scale: 1 in = 33 ft; vertical scale: 1 in = 71 ft.

lows of varying amplitudes. However, overall, the signature does not display the magnetic complexity commonly found at historic shipwrecks. These magnetics are associated with two objects on side-scan sonar records; one of which appears to be an angular and somewhat "boxy" feature. However, the other object is almost certainly a piece of pipe. Both objects project above the bottom and their spatial proximity suggests they may be related. In light of the intensity and long period of oil and gas extraction activities in the area, it is believed most likely that both of these objects are derived from those operations. The preponderance of the available evidence indicates that Target 1 is unlikely to be related to a sunken vessel. Therefore, no additional work is required at this target.

Target 2

Target 2 is a relatively intense magnetic signature located near the center of Area 1, between the TET pipeline and the pair of Chandeleur Pipelines (see Figure 3-4b). The water depth at this target is about 16 ft. No objects were seen on side-scan sonar records at this target. This magnetic anomaly was recorded on 5 adjacent survey lines (lines 19 through 24) and produced a magnetic signature measuring approximately 650 ft long by 200 ft wide (Figure 3-8). The center of the anomaly is at state plane coordinates: N=354,100; E=4,001,120. The magnetic signature consists of a dipole, an adjacent monopole low and a less intense monopole high. The total magnetic deviation of the dipole was 3680 gammas. This signature can be characterized as complex in that it contains multiple magnetic peaks, a characteristic of historic shipwrecks. However, as can be seen in Figure 3-8, the amplitudes of the two lows in the signature are roughly the same, 46960 and 47105 gammas. The general assumption is that the amplitudes of magnetic anomalies on a shipwreck will vary considerably as a result of great differences in size and shape of ferrous elements. The similarity in amplitude of the two lows at Target 2 may be indicative of two objects of similar mass.

The intensity and configuration of this magnetic signature suggests the presence of two or more relatively massive metal objects, although the identity of the object(s) cannot be determined from the magnetic signature alone. The fact that no features can be seen on side-scan sonar records suggests that the source object or objects are buried. As noted earlier, the project area contains numerous objects related to oil and gas extraction activities, as well as objects from modern vessels traveling the MRGO. Although the magnetic signature of Target 2 can be considered complex, it is only barely so, plus the two principal anomalies display low gradients of roughly similar amplitudes. The relatively shallow depth at Target 2 (16 ft) means that the magnetometer sensor was close to the bottom when crossing this area. It is expected that even relatively small objects, such as those resulting from a scattered shipwreck, would be recorded. However, this was not the case. The magnetic data presented in Figure 3-10 is contoured at a 200-gamma interval; this high interval selected because of the density of contour lines produced at lower intervals. Even when the data are contoured at lower intervals, such as 50 gamma, the same configuration shown in Figure 3-8 is seen; a dipole and the adjacent monopole low and the less intense monopole high. The magnetics do not reveal the presence of smaller objects scattered around the target area, as would be most likely expected at a shipwreck. Therefore, even though the magnetic signature at Target 2 displays some of the characteristics of shipwreck magnetics, it, also, displays characteristics of magnetic signatures that can be associated with the types of modern debris known to exist throughout the area, specifically large pieces of iron pipe or similar items resulting from oil and gas extraction activities. It is presently impossible to identify the source of the magnetics for Target 2. Physical examination by divers will be required to determine the identity of this target. Recommended procedures for conducting diver identification of Target 2 are provided in the following chapter, in the event the New Orleans District decides on this course of action.

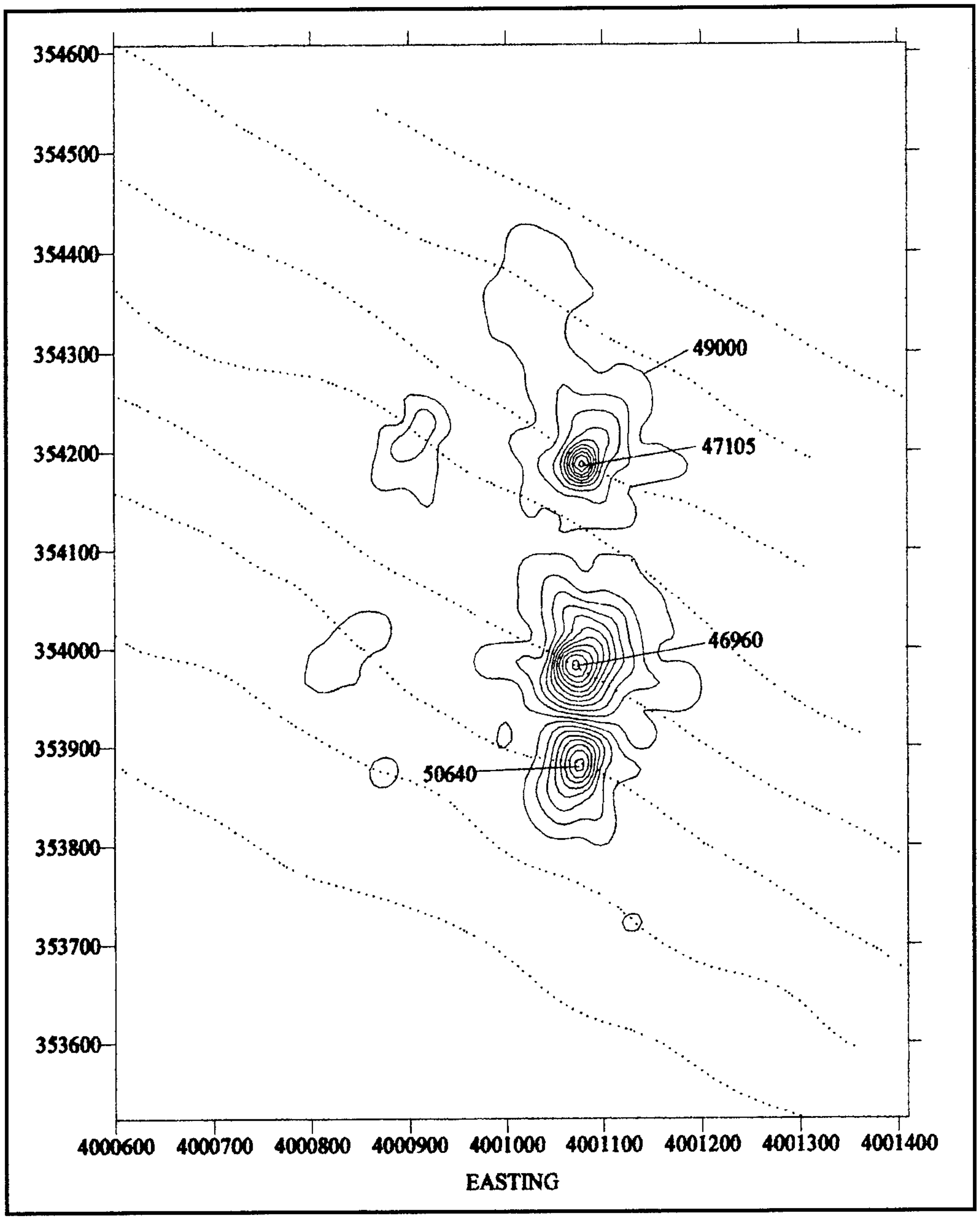


Figure 3-8. Magnetic signature of Target 2, Area 1. Survey vessel tracks are shown. Contour interval = 200 gammas.

Target 3

Target 3 is located about 1000 ft south of the pair of Chandeleur Pipelines (see Figure 3-4c). This relatively intense magnetic anomaly was recorded on 2 adjacent survey lines. As shown in Figure 3-9, this signature is a dipole measuring approximately 200 ft square with a maximum magnetic intensity of 2285 gammas. Target 3 is in about 22 ft of water and is located at state plane coordinates: N=352,150; E=4,004,565. No object appeared on side-scan sonar records at this target. The magnetic signature of Target 3, although intense, is

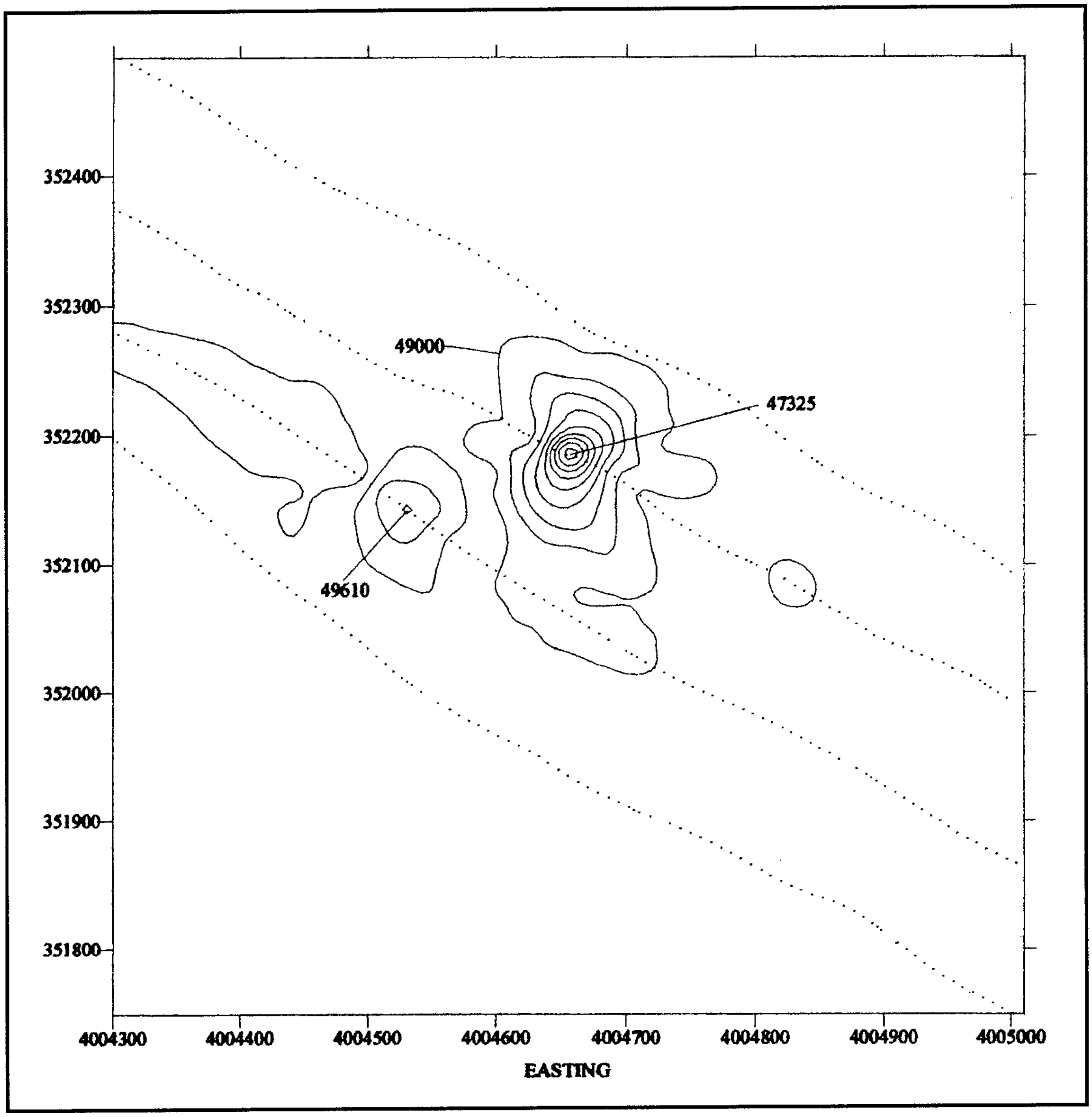


Figure 3-9. Magnetic signature of Target 3, Area 1. Survey vessel tracks are shown. Contour interval = 200 gammas.

characterized as a simple dipole, probably related to a single object. The signature does not show the typical characteristics of shipwreck magnetics, and it is believed that the source object for Target 3 is most likely to be a single piece of modern trash or debris.

Target 4

Target 4 is located at the extreme eastern edge of the project area, approximately 4,000 ft south of the pair of Chandeleur Pipelines in water that is about 25 ft deep (see Figure 3-4c). Magnetics were recorded only on the last two survey lines (lines 28 and 29). However, when the magnetic data for this target are more carefully examined, it appears as if the magnetics are

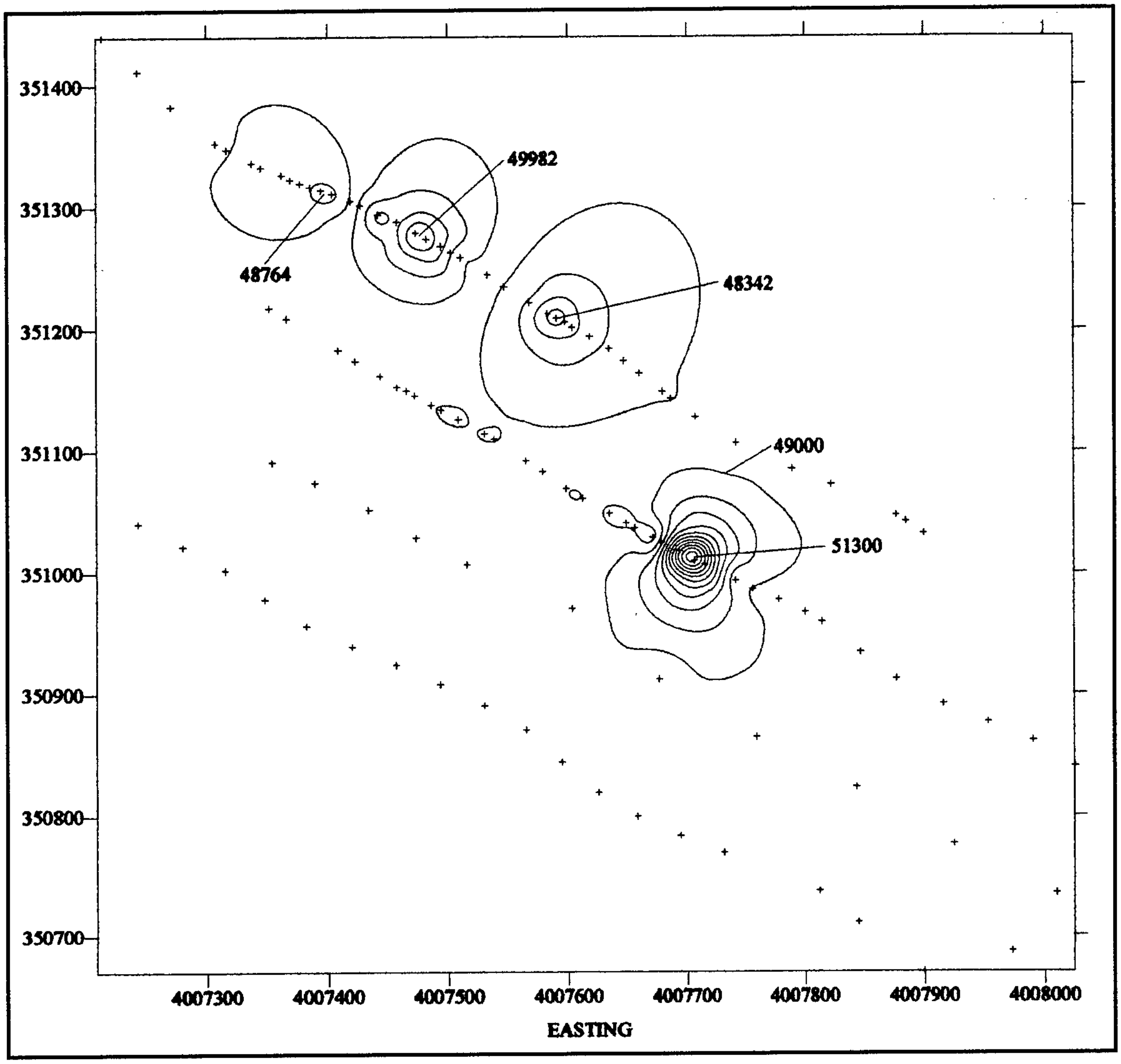


Figure 3-10. Magnetic signature of Target 4, Area 1. Survey vessel tracks are shown. Contour interval = 200 gammas.

related to several widely scattered objects, none of which produce signatures extending across adjacent survey lines (Figure 3-10). The magnetic data in Figure 3-10 are plotted at a 200-gamma interval, because lower intervals produce very dense lines, difficult to distinguish from one another. However, plotting these data at lower intervals still revealed signatures associated with single survey lines. The data also suggest that the source objects for the magnetics on the outside line (line 29, the uppermost line in Figure 3-10) may lie outside of the project area. No side-scan sonar targets were seen at this target. The center of this target is located at state plane coordinates: N=351,100; E=4,007,600. It is believed that the source objects for Target 4 are most likely to be individual pieces of modern trash and debris, not shipwreck remains.

Target 5

Target 5 is a dipolar magnetic anomaly located on the extreme eastern edge in the upper one-third of Area 1 (see Figure 3-4b). This magnetic anomaly was recorded only on the last

two survey lines, lines 28 and 29, in about 21 ft of water at state plane coordinates: N=360,0450; E=3,991,225. The signature covered an area approximately 125 ft square and had a magnetic intensity of 350 gammas. Analysis of side-scan sonar records revealed that this magnetic anomaly was associated with a piece of pipe lying on the seafloor at the immediate edge of the project area, or slightly outside of it. This pipe is believed to be a piece of modern debris and is not considered significant.

Area 2

The northern portion of the project area is designated Area 2. The long axis of this area is oriented approximately north-northwest by south-southeast and it measures 6.06 mi long. The eastern edge of Area angles somewhat toward the northwest such that the area is trapezoidal rather than rectangular in shape. As shown in Figure 3-11, a total of 29 survey transects were run along the long axis of Area 2 to achieve complete coverage.

Figure 3-12 presents contoured bathymetric data for Area 2. The shallowest part of Area 2 is just northwest of the center, where water depths are on the order of 15 ft. From there, the bottom slopes gradually down toward the northwest, reaching about 18 ft at the extreme northwestern (i.e., upper) end of the project area. The bottom in the northern one-third of Area 2 is relatively flat. In the lower two-thirds of Area 2, the bottom slopes downward toward the southeast, from a depth of 15 feet to 23 or 24 ft. This southern half of Area 2 contains several pronounced humps on the bottom, some of which rise to within 12 or 13 ft of the surface. These 5-to-6-ft high bottom features were easily discerned on side-scan sonar records as well as the fathometer, but none displayed any significant magnetics (Figure 3-13). Most were fairly small, covering an area less than 200 ft or so across and it is believed that all represent piles of fairly recent dredged material deposited from the MRGO. These deposits have not yet been dispersed by currents and waves, but it is expected that over time these features will tend to flattened out as the sediment is scattered.

Figure 3-11 presents contoured magnetic data for Area 2 at a 40-gamma contour interval. Several oil or gas related features were recorded in Area 2. A gas platform (identified as well Kerr-McGee No. 1) was located in the approximate center of the northern portion of Area 2. The state plane coordinates (Louisiana South Zone, NAD 1983) for this platform are: N=380,308.4; E=3,959,478.6. As shown in Figure 3-11b, this platform produced a very large magnetic anomaly recorded on 7 survey lines. Magnetic data show a pipeline running off of this platform toward the southeast and out of the project area (see Figure 3-11). This pipeline was not marked by any markers or signs.

Five other pipelines or similar structures were recorded in Area 2. One probable pipeline extends across the northwestern corner of the area. This line was recorded on only the first four survey lines (Figure 3-11a). The other probable pipelines extend entirely across Area 2. These include a set of 3 pipelines extending roughly east-west across the approximate center of the area (Figure 3-11c). These lines produced rather typical pipeline signatures, generally, with strengths on the order of several hundred to over 1,000 gammas. Several smaller magnetic anomalies were recorded in the immediate vicinity of these 3 pipelines, plus several objects were recorded in this area on side-scan sonar records. All of these side-scan images appear to be small, linear objects, presumably pieces of pipe or cable. It is believed that these side scan-sonar targets and the magnetic anomalies represent scattered debris associated with either the construction of the pipeline or with subsequent repairs made to it.

However, one set of magnetics produced a linear pattern running east-west across the pipelines (see Figure 3-11c). These relatively weak magnetics may represent a cable extending across the bottom in this area. It is not known if this cable is in some way related to the three pipelines.

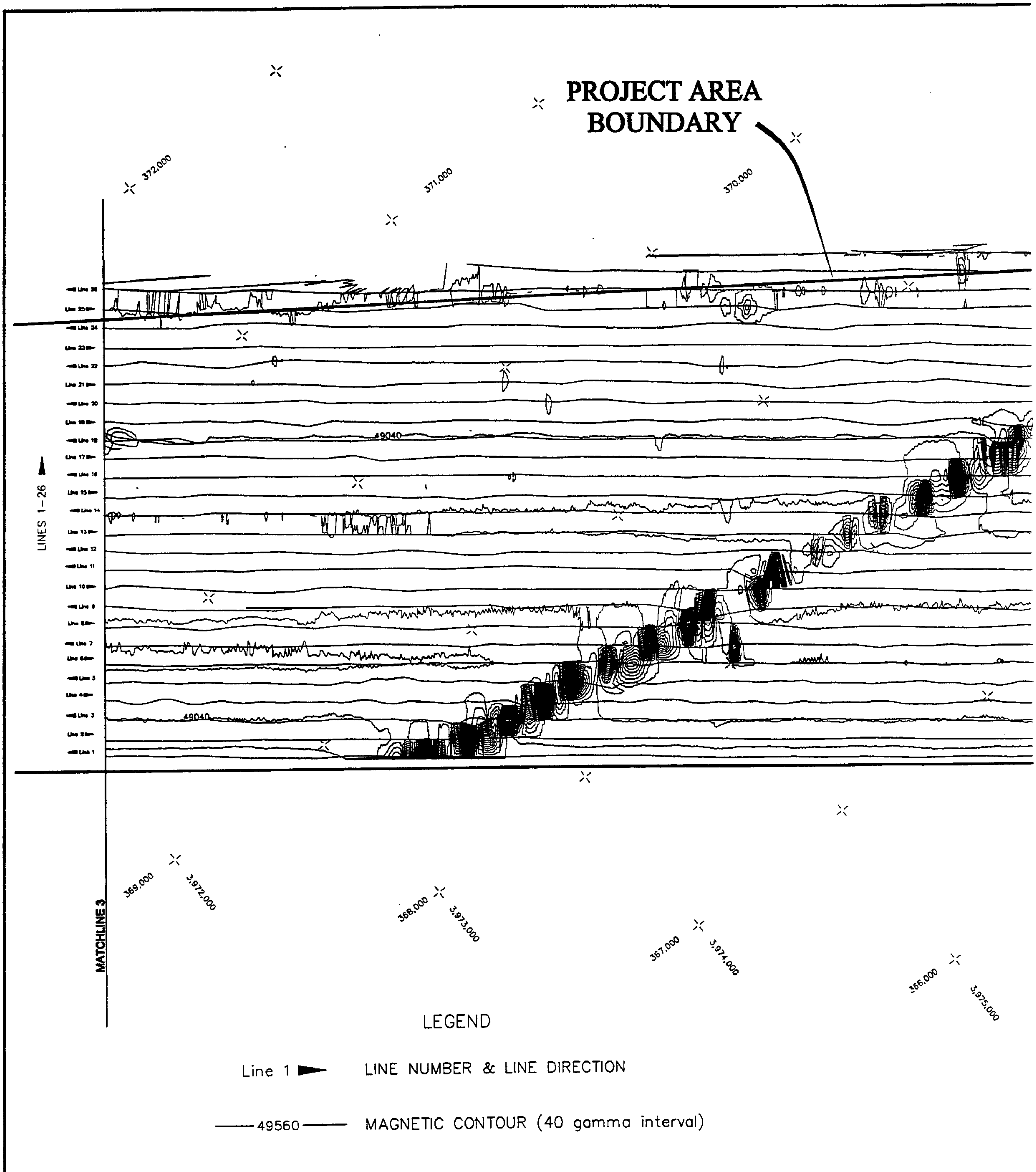
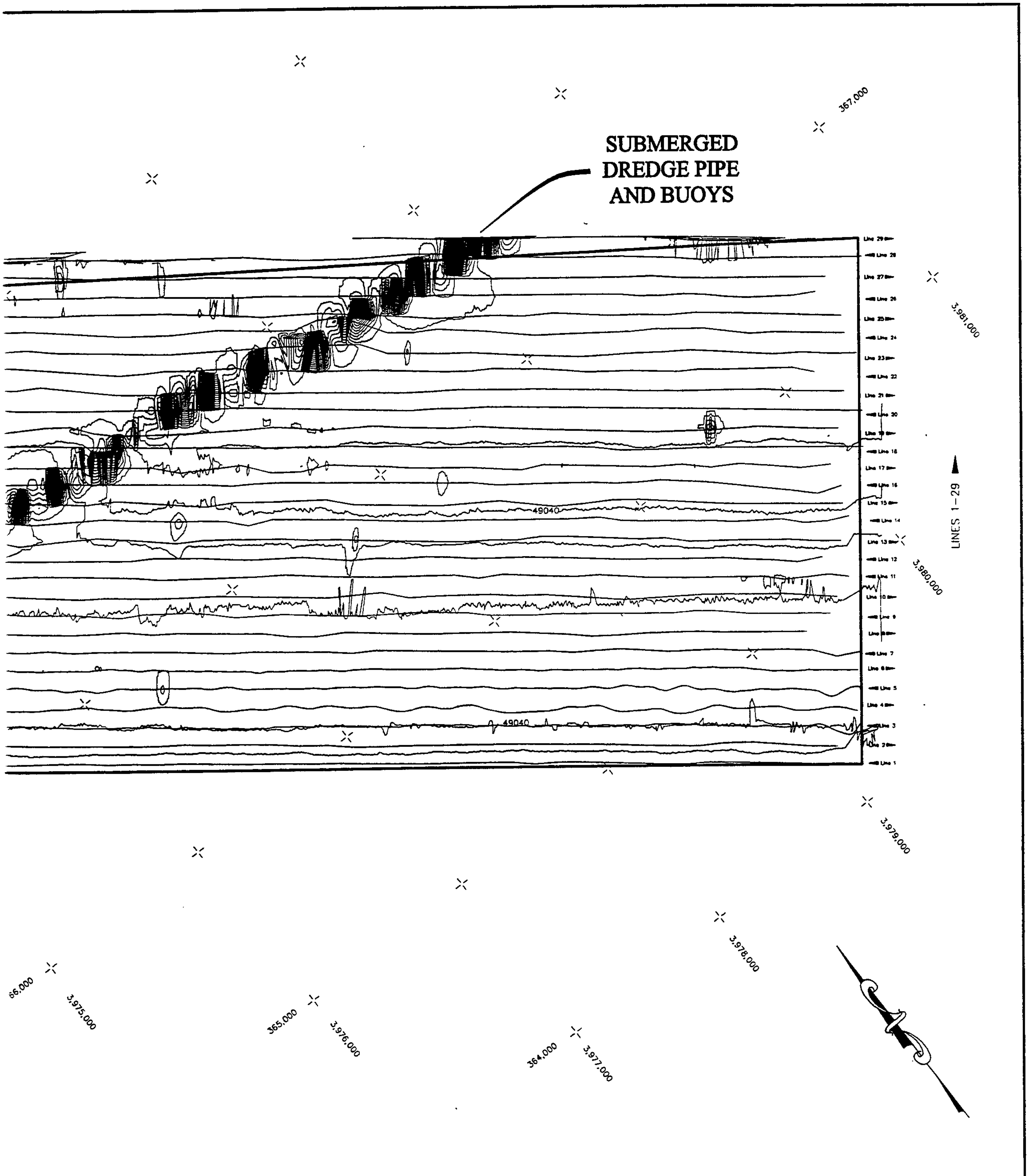


Figure 3-11d. Contoured magnetic data and survey vessel tracks in Area 2. Contour interval = 40 gammas.


SUBMERGED
DREDGE PIPE
AND BUOYS
LINES 1-29
49040
367,000
366,000
365,000
364,000
3,981,000
3,980,000
3,979,000
3,978,000
3,977,000
3,976,000
3,975,000

2

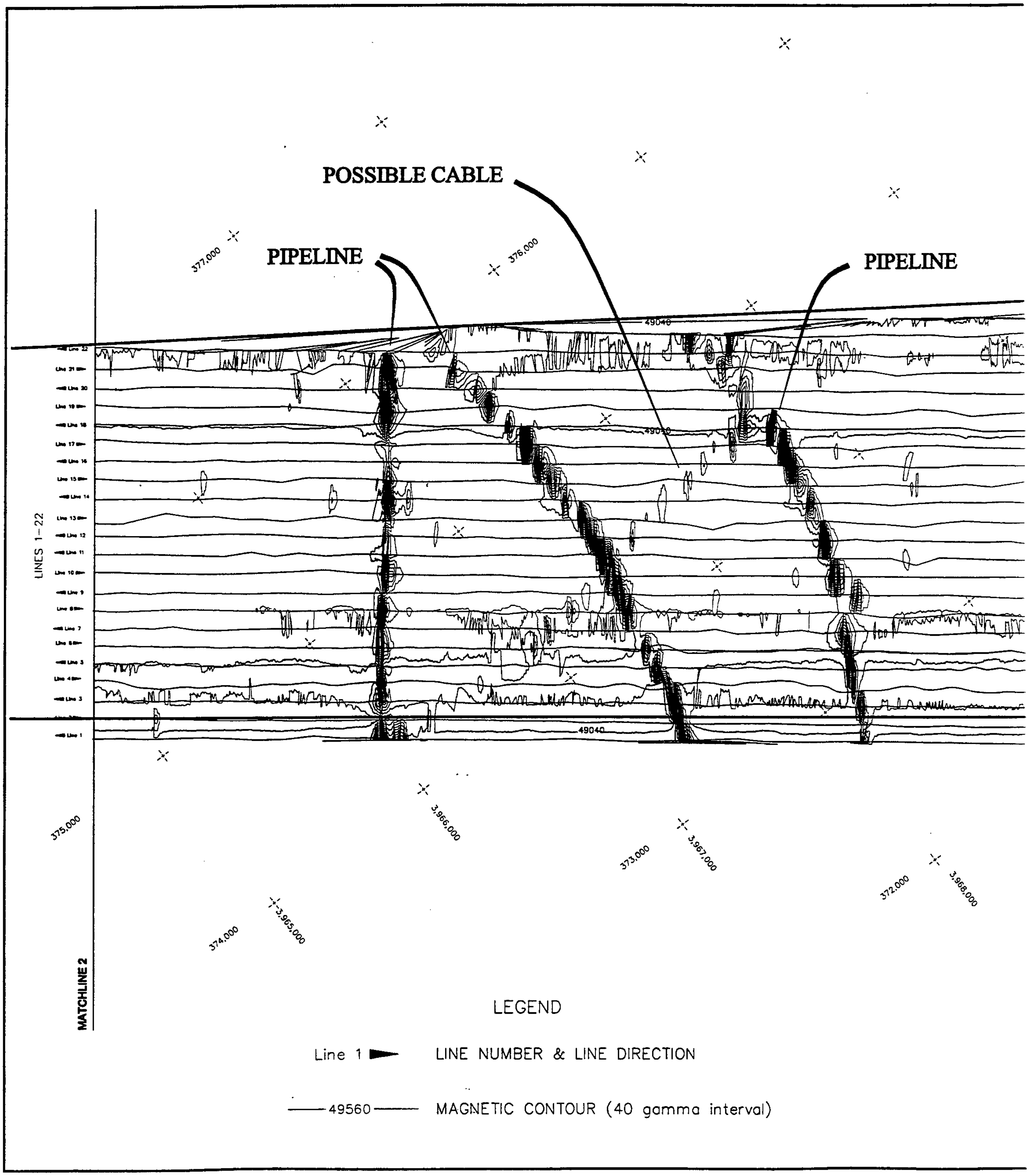
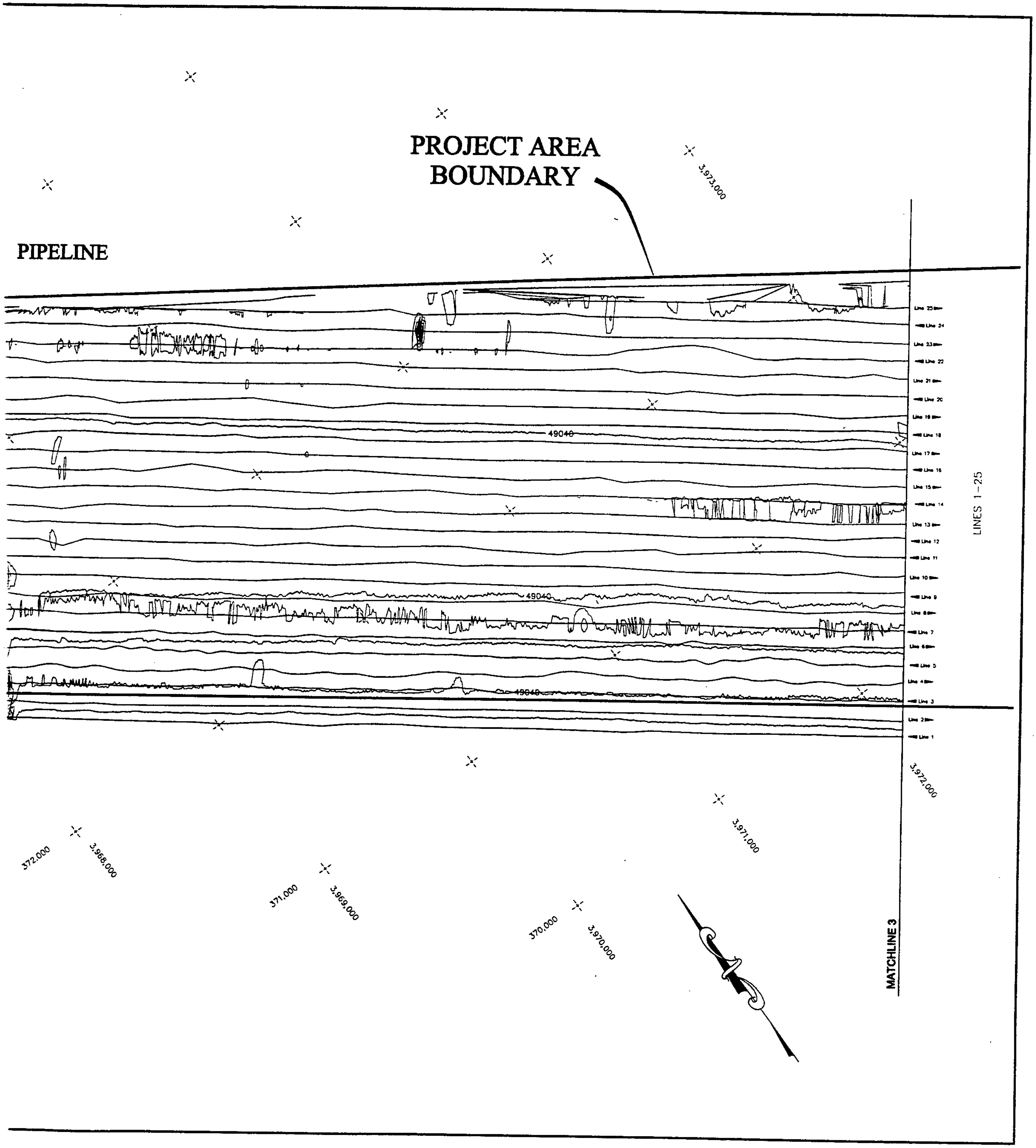


Figure 3-11c. Contoured magnetic data and survey vessel tracks in Area 2. Contour interval = 40 gammas.

(7)


PROJECT AREA
BOUNDARY
PIPELINE
3,973,000
49040
49040
49040
LINES 1–25
3,972,000
3,971,000
372,000
3,968,000
371,000
3,969,000
370,000
3,970,000
MATCHLINE 3

2

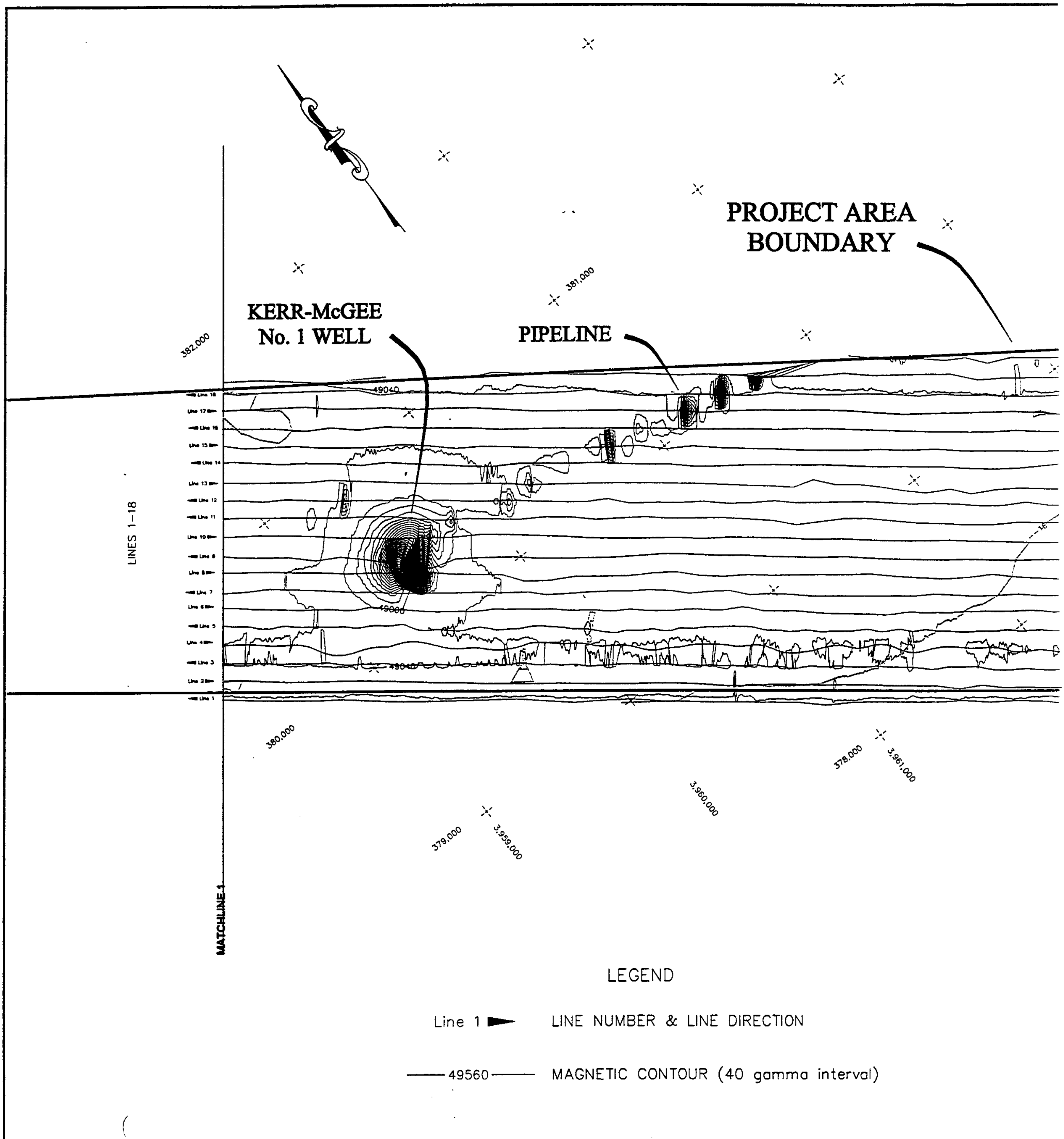
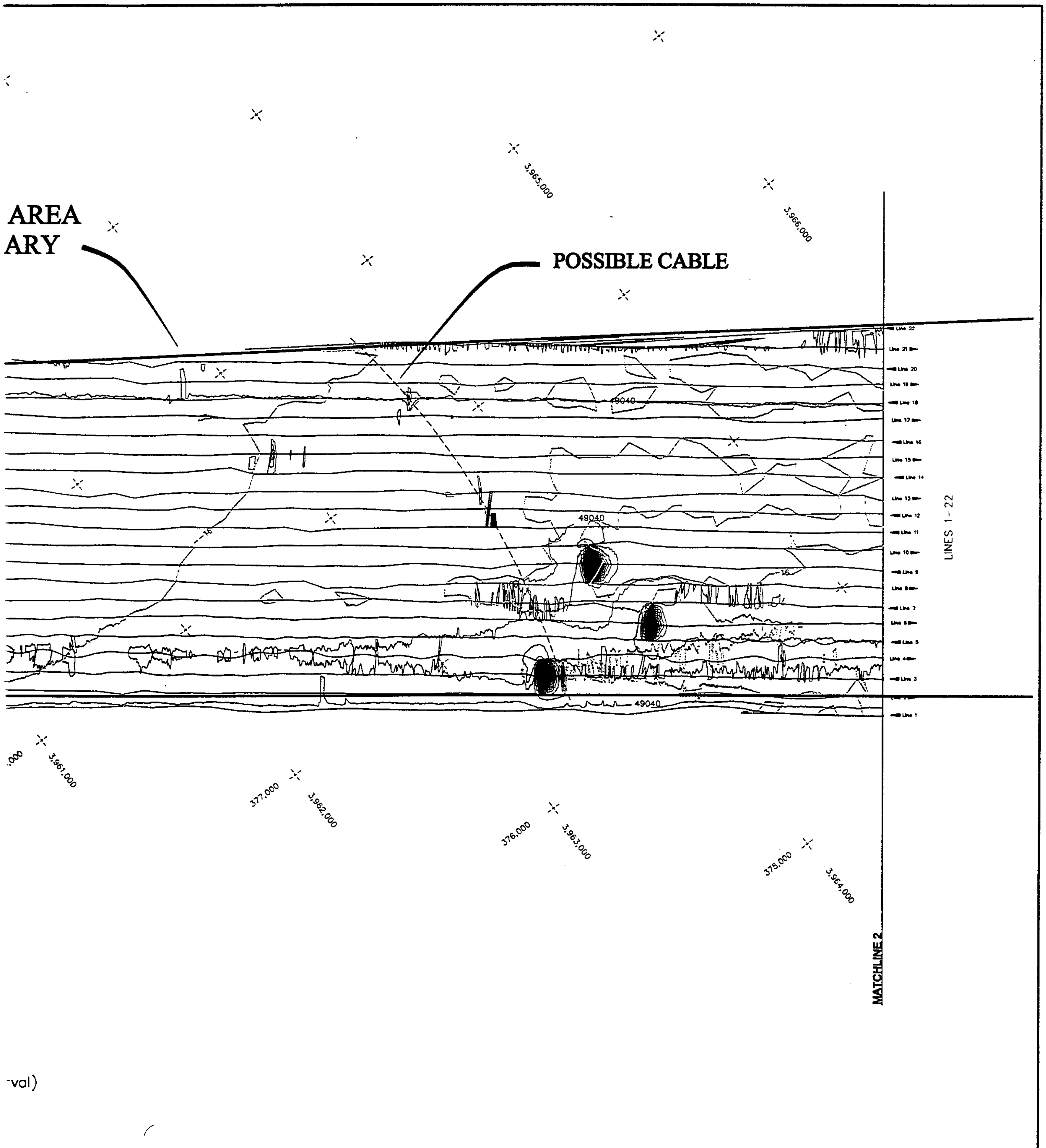


Figure 3-11b. Contoured magnetic data and survey vessel tracks in Area 2. Contour interval = 40 gammas.


AREA
ARY
POSSIBLE CABLE
3,965,000
3,966,000
49040
49040
49040
LINES 1 – 22
3,961,000
377,000
3,962,000
376,000
3,963,000
375,000
3,964,000
MATCHLINE 2
-val)

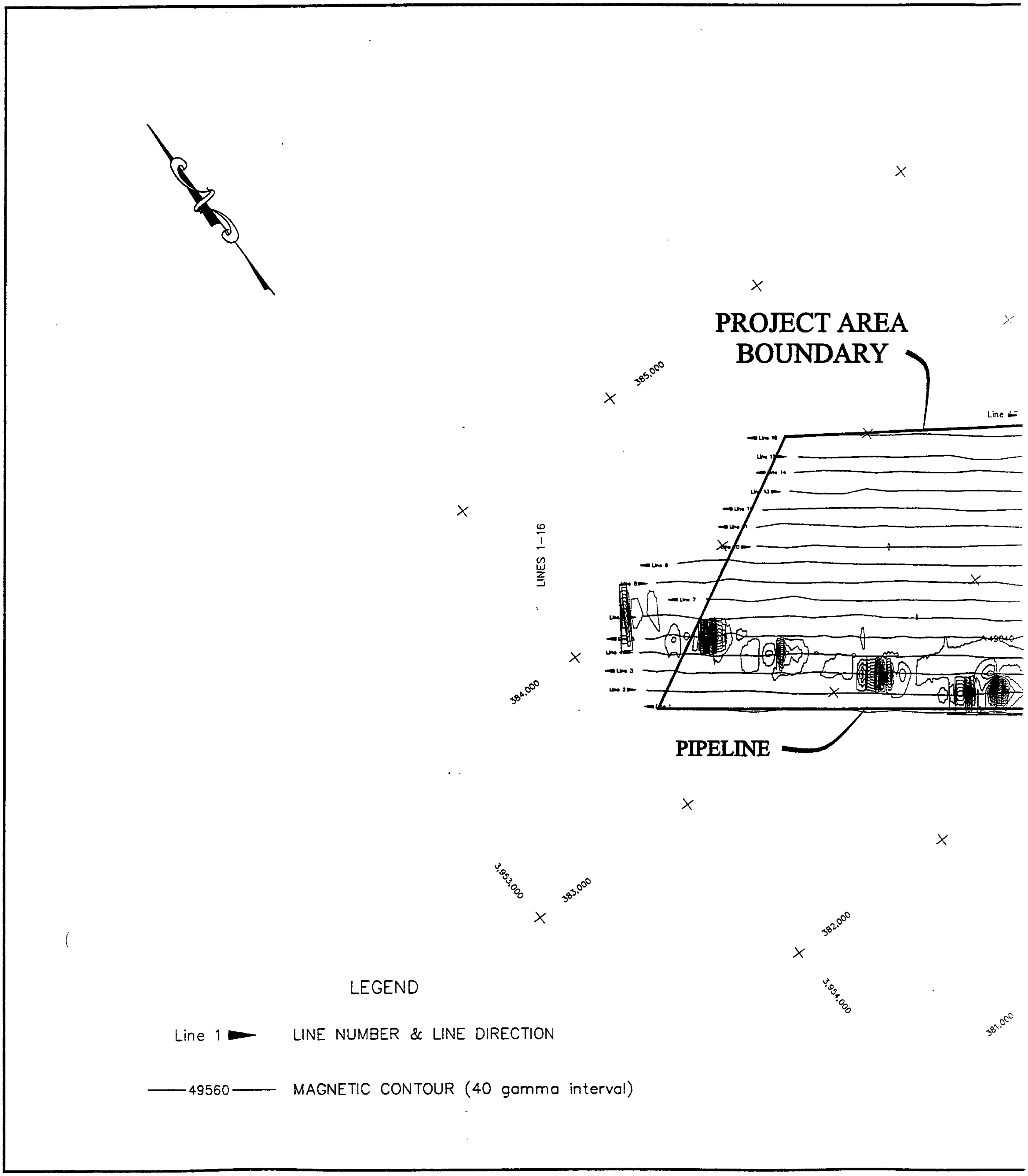
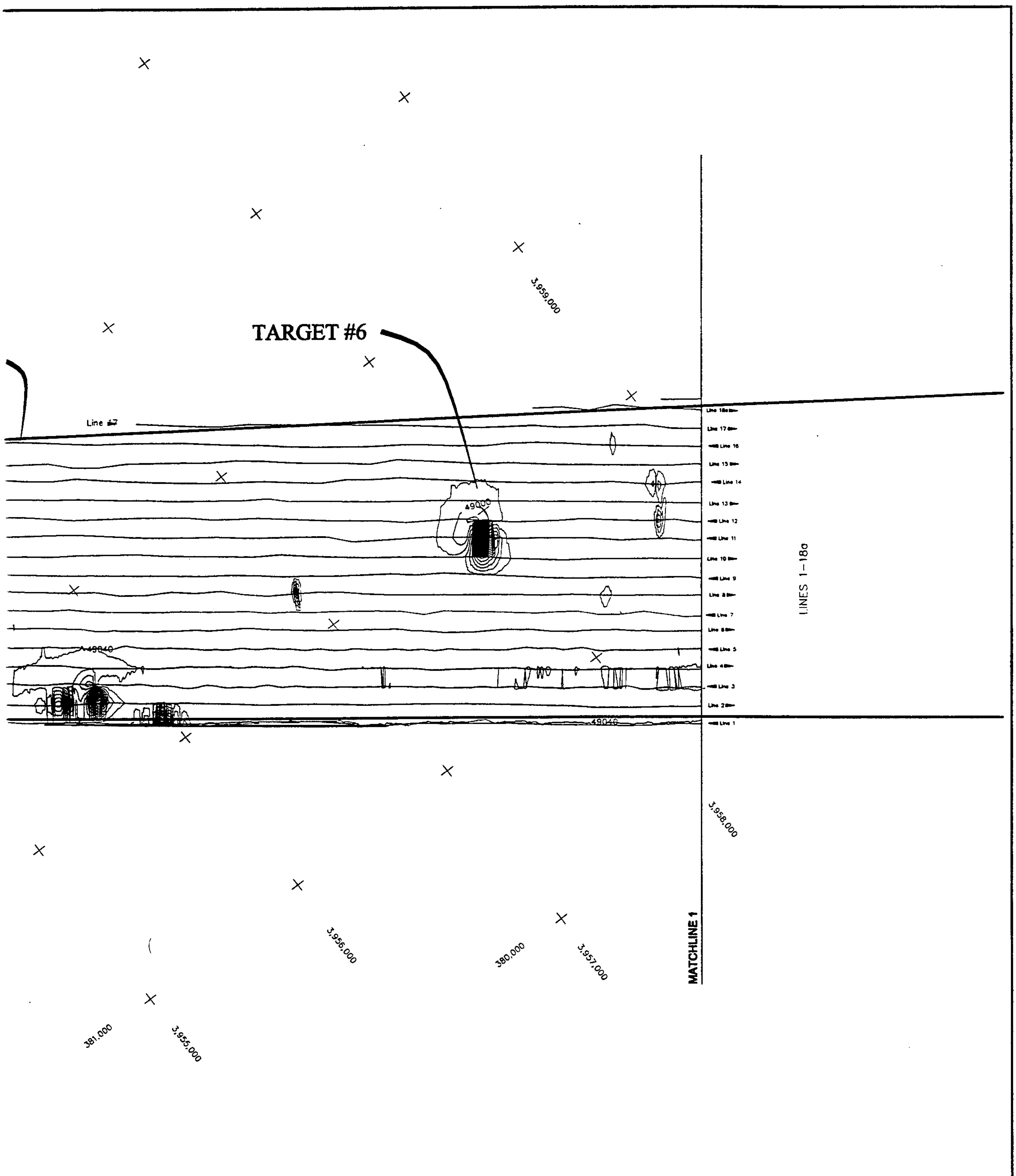


Figure 3-11a. Contoured magnetic data and survey vessel tracks in Area 2. Contour interval = 40 gammas.

1


TARGET #6
Line #7
LINES 1-18a
MATCHLINE 1
3,959,000
3,958,000
3,957,000
3,956,000
3,955,000
380,000
381,000
49000
49040
49048

2

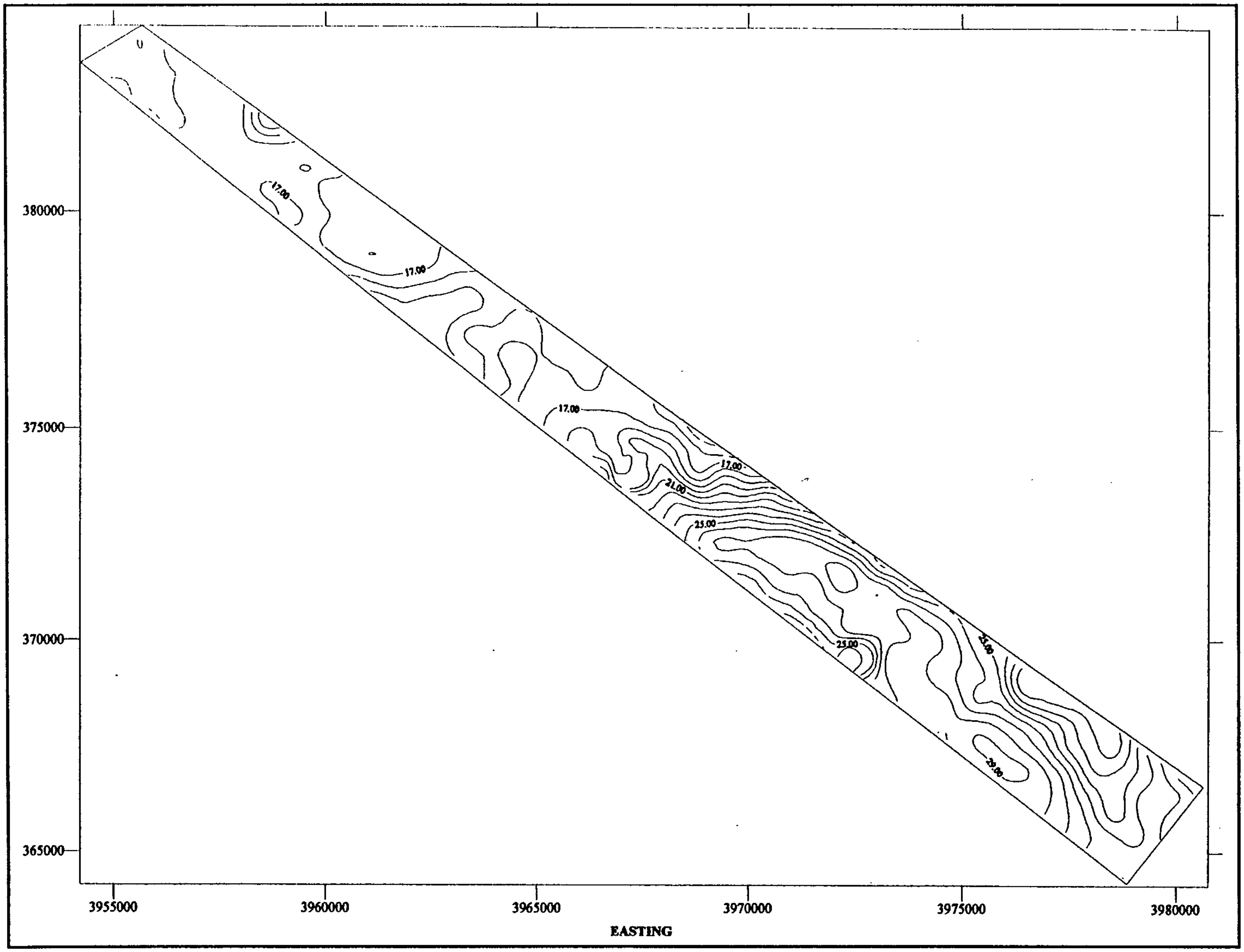


Figure 3-12. Bathymetry in ODMDS Area 2. Contour interval is 1 ft. Grid is state plane coordinates, NAD 1983.

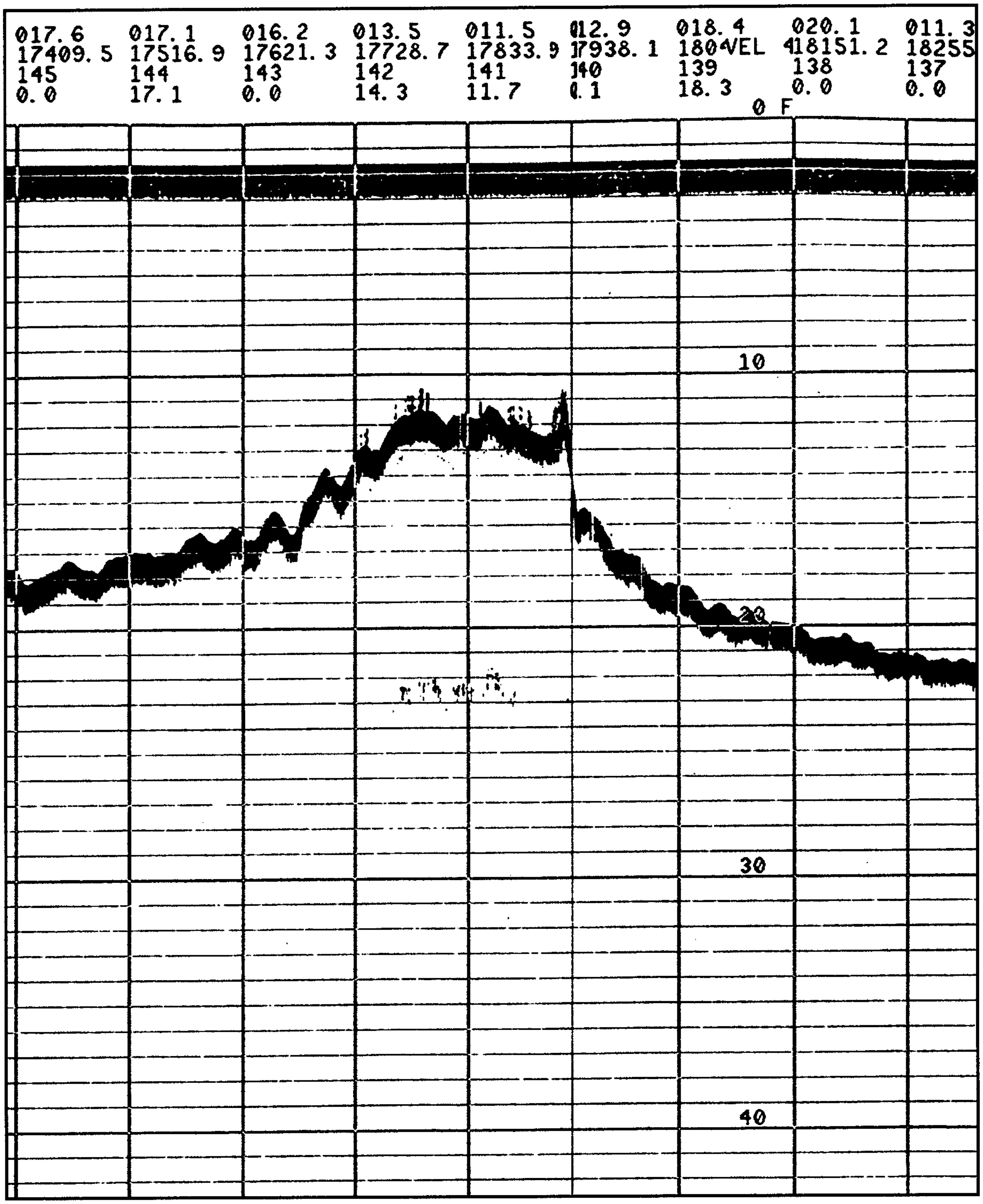


Figure 3-13. Fathometer record of one of the undispersed piles of dredged material recorded in ODMDS Area 2. Vertical scale in feet, horizontal scale = 100 ft between lines.

Approximately 4,000 ft northwest of this set of pipelines, another set of magnetics produced a long linear feature extending entirely across the project area (see Figure 3-11b). This object produced relatively low intensity magnetics on each survey line, normally ranging from about 25 to 100 gammas, although on a few lines, signatures of over 100 gammas were recorded. Because Figure 3-11 is contoured at a 40-gamma interval, the magnetics recorded on most lines are not shown. This feature was originally thought to be a pipeline, however, its magnetic signature is not that of a typical pipeline. The magnetic signatures covered an area of about 80 to 100 ft along each survey track. If this object is a pipeline, it is a very small pipe, possibly a "flow line" connecting well sites. Alternatively, it is possible that this feature is a cable of some sort, possibly a communication cable, although no signs marking the cable were noted in the field.

While the survey of Area 2 was being conducted a 'cutter head' dredge was operating in the MRGO just south of Breton Island and the dredged material was being piped across the southern end of Area 2 and deposited on the island. This pipeline and its associated anchors and buoys created a huge magnetic signature and a very obvious side-scan sonar feature extending entirely across the southern portion of Area 2 (see Figure 3-11d).

Targets of Interest

Target 6

Only one target of interest was identified in Area 2. Designated Target 6, this target was identified during post field processing of the collected remote-sensing data and is located approximately 2,000 ft north of the Kerr-McGee well platform in the upper end of Area 2 (see Figure 3-11a). The state plane coordinate for the center of this target is: N=381,900; E=3,957,800. Target 6 was recorded only on magnetometer records; no objects were recorded at this location on side-scan sonar records, meaning that the source object is buried. This magnetic signature covered an area measuring approximately 200 by 360 ft in size and produced a maximum intensity of 2770 gammas. The water depth at this target is 16 ft (Figure 3-14). Although this anomaly was relatively intense and was recorded on four adjacent survey lines, when contoured the magnetic signature appears as a simple dipole and does not display a "complex" magnetic signature with differential amplitudes that is most typical of shipwreck remains. This signature is more characteristic of a single object, although probably something that is fairly large in size, such as a large piece of pipe, a large anchor or something similar. Although some distance from the Kerr-McGee well, it is possible that the source object for this anomaly is debris or structural material from the well structure. Several smaller magnetic anomalies were recorded in the vicinity of the well site, a rather typical finding and believed to represent trash and debris associated with the well. The side-scan sonar recorded a number of obvious drag marks on the bottom in the vicinity of the well site, almost certainly produced by the leg pads on a jack up barge. This suggests that some relatively recent repairs or maintenance work has been done on the well structure, meaning that some of the small magnetic anomalies around the well site, as well as the more distant object producing the Target 6 signature, might represent discarded structural material, other metal debris, or tools that were lost or purposefully thrown overboard during this most recent, or earlier, episodes of repair. In light of the characteristics of the magnetic signature of Target 6, plus these presumptions about its source, it is believed that this target is unlikely to be a significant cultural resource.

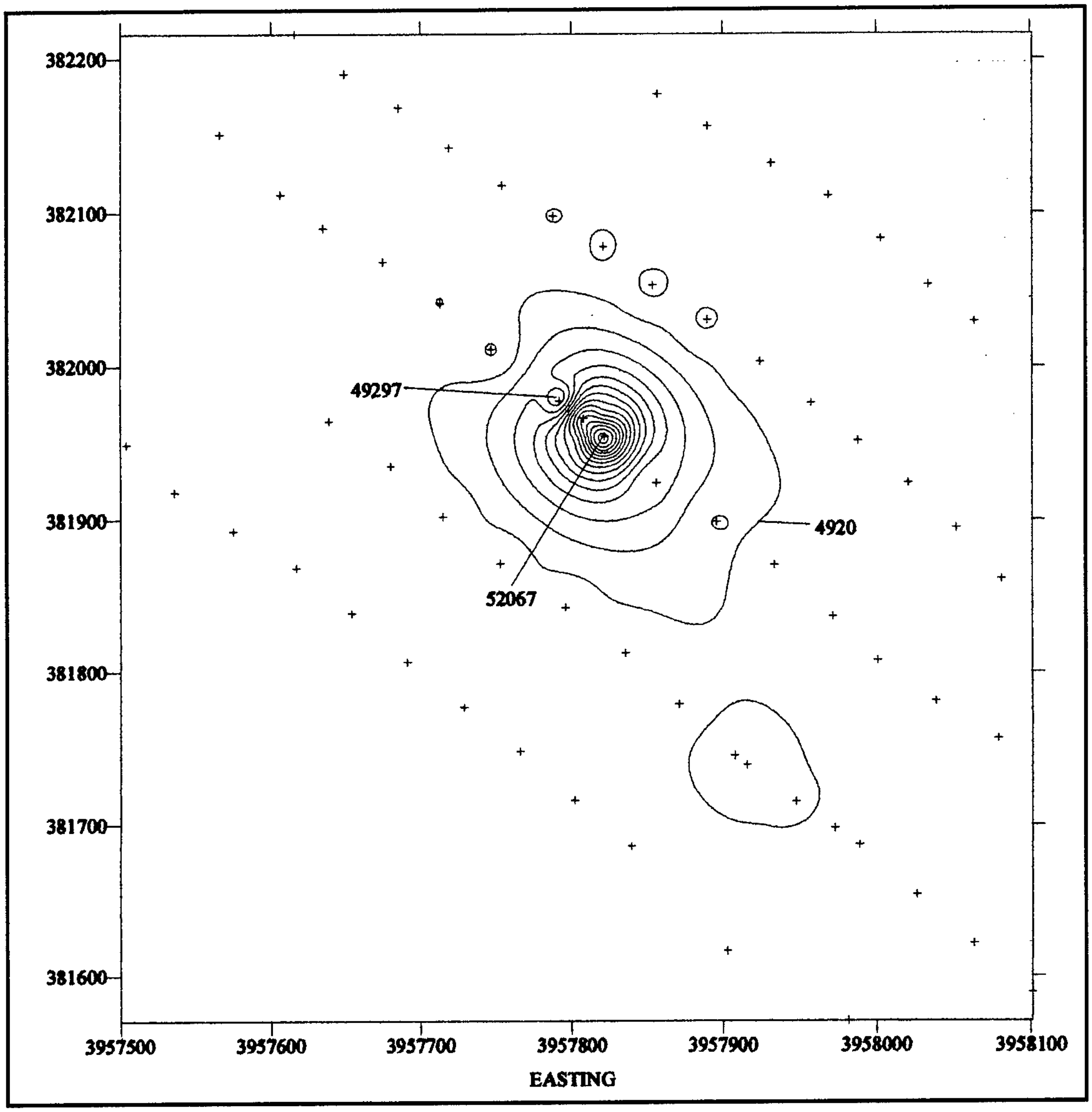


Figure 3-14. Magnetic signature of Target 6, Area 2. Survey vessel tracks are shown. Contour interval = 200 gammas.

CHAPTER 4

CONCLUSIONS AND RECOMMENDATIONS

Summary of Findings

The remote-sensing survey of the Mississippi River Gulf Outlet, Offshore Dredged Material Disposal Site involved the collection of over 425 linear miles of remote-sensing data. The primary objective of the survey was to locate historic shipwrecks or other potentially significant cultural resources in the project area. In conjunction with the survey, information was collected on the history of navigation and vessel loss in the area in order to clarify its potential for containing historic shipwrecks. This research has indicated that historic vessels have been lost in the general area, although no wrecks are reported from within the project area itself. Further, this historical research revealed that prior to the 1940s, vessel traffic in the project area was relatively light. Since the discovery of oil and gas in the western Breton Sound area in the 1940s, there has been a tremendous increase in vessel traffic in the project area as wells were drilled, platforms constructed, and pipelines and cables laid. All of this activity has resulted in the accumulation throughout the area of various sorts of trash and debris associated with these activities.

A large number of magnetic anomalies and side-scan sonar targets were recorded in the study area during the remote-sensing survey. Most of these targets are interpreted as modern debris or are identified as non-significant cultural properties, such as oil or gas pipelines, abandoned well structures, and dredge pipe. Additionally, a large number of discreet magnetic anomalies are clustered along the eastern side of the project area, probably the result of redeposited debris from dredging operations in the MRGO. These redeposited items exist in secondary contexts and are unlikely to represent significant remains. Seidel et al. (1998:80) report a similar clustering of small, nonsignificant, magnetic anomalies close to a navigation channel in their remote-sensing survey of the Atchafalaya ODMDS in Atchafalaya Bay, Louisiana.

Six targets in the study area exhibited magnetic signatures and/or side-scan sonar images suggestive of possible shipwrecks or significant cultural resources. Further examination of these targets resulted in the elimination of five of them (Targets 1, 3, 4, 5, and 6) as possible vessel remains. The indications are that the sources for these five targets are relatively modern items, most likely related to oil and gas extraction activities. The other target, Target 2, consists of a fairly large, intense and complex magnetic signature. No side-scan image was observed at the target location, suggesting that the source object is buried. While it is possible that this target is related to modern debris, this possibility cannot be verified with the data at hand. Identification of the source of Target 2 will require diver verification.

The findings of the remote-sensing survey of the Mississippi River Gulf Outlet, ODMDS are not unlike those reported from other similar settings where modern usage of a waterway or water body is high. For example, Pearson (1987) recorded numerous, small magnetic anomalies in the Laguna Madre near Port Isabel, located on the extreme southern Texas coast. The anomalies were concentrated in an area heavily used by small boat traffic and it was argued that the magnetics were largely the result of modern debris lost or thrown from boats. More direct equivalents to the present study are results from recent surveys in Aransas Pass and the Corpus Christi and La Quinta Ship Channels in Texas (James and Pearson 1991, Pearson and Simmons 1995); from Mobile, Pascagoula, Galveston and Matagorda bays, where modern commercial vessel traffic is fairly high (Irion 1986; Mistovich and Knight 1983; Mistovich et al. 1983; Pearson and Hudson 1990), from Cat Island Pass, Terrebonne Bay, Louisiana (Birchett and Pearson 1997), and from the Atchafalaya Bay ODMDS (Seidel et al. 1998). In remote-sensing studies conducted in these settings, modern debris was abundant and constituted the bulk of the magnetic signatures recorded. The intensive use of the waters around Breton Island and the ODMDS by the oil and gas industry has only added to the potential for the accumulation of modern debris.

The problems of differentiating between modern debris and shipwrecks on the basis of remote-sensing data have been discussed by a number of authors. This difficulty is particularly true in the case of magnetic data. There is no doubt that the only positive way to verify a magnetic source object is through physical examination. However, the size and complexity of a magnetic signature do provide a usable key for distinguishing between modern debris and shipwreck remains (see Garrison et al. 1989a, b; Pearson and Hudson 1990). Specifically, the magnetic signatures of shipwrecks tend to be large in area and tend to display multiple magnetic peaks of differential amplitude. Modern debris (at least individual pieces of debris), on the other hand, tends to produce magnetic signatures that are small in area and that display single magnetic peaks or multiple peaks of similar amplitude. Most magnetic signatures recorded during the present survey tended to exhibit these latter characteristics.

Pearson and Hudson (1990:40) have argued that the past and recent use of a water body must be an important consideration in the interpretation of remote-sensing data; in many situations the most important criterion. Unless the remote-sensing data or the historical record provide compelling and overriding evidence to the contrary, it is believed that the history of use should be a primary consideration in interpretation. What constitutes "compelling evidence" is, to some extent, left to the discretion of the researcher; however, in a setting such as the present project area, where modern oil and gas-related activities and fishing activities have been intensive, the presence of a large quantity of modern debris must be anticipated. The material related to oil and gas extraction activities, in particular, will be concentrated in the vicinity of well and pipeline structures, although it may be scattered anywhere that supply and work vessels travel. This is exactly the pattern observed in the remote-sensing records obtained in the ODMDS. Material lost or discarded from commercial vessels using the MRGO will concentrate along the navigation channel, outside of the boundaries of the ODMDS. However, it is believed that some of these objects are removed from the MRGO channel during dredging and are redeposited in the ODMDS. Most of the objects related to these activities appear on remote-sensing records as discrete, small objects and the concentration of numerous small, individual magnetic signatures and side-scan sonar objects in the portion of the ODMDS closest to the MRGO is believed to be a result of past dredging activities. The dredging activity, itself, is likely to result in the deposition of numerous objects in the ODMDS. For example, the dredge pipe extending across the southern end of Area 2 during the present survey was marked by numerous iron buoys connected to the pipe with wire cables. There seems to be no doubt that during the deployment, movement and dismantling of dredge pipe many objects can be lost, including pieces of wire cable, pipe, anchors, and any number of large iron bolts, nuts, etc., that are used to attach the various pieces of dredging paraphernalia together. Even the large iron buoys can break loose and, if punctured, will sink; as evidence by a partially

submerged buoy that was found drifting some distance west of Area 1. There is no doubt that this buoy had broken loose from the dredge pipe crossing Area 2 and had drifted well over a mile away.

With the single exception noted, none of the targets in the project area exhibited characteristics sufficiently compelling to override the assumption that they represent modern debris. Diver evaluation of numerous similar targets in similar settings provides sufficient information to argue that these targets most likely represent non-significant, modern debris and trash.

Recommendations

This study was undertaken as part of the New Orleans District's compliance with Section 106 of the National Historic Preservation Act that requires Federal agencies to take into account the effects of their undertakings on historic properties (Advisory Council on Historic Preservation 2000). Specifically, the present study was conducted to identify cultural properties within the Mississippi River Gulf Outlet, ODMDS, under the assumption that any significant properties that might exist could be adversely impacted by future episodes of disposal of dredged materials into the project area. The remote-sensing survey located one "target of interest" which could represent the remains of an historic vessel. This target, identified as Target 2, displays a magnetic signature that shares some, but not all, of the characteristics of magnetic signatures of known historic wrecks. It is recommended that the New Orleans District either avoid the location of Target 2 as an area for future dredged material disposal or, if this is not possible, then Target 2 should be examined by divers to determine its identity and significance.

Avoidance is recommended as the preferred alternative. If Target 2 is to be avoided, it is recommended that no dredged material be placed within 500 ft of the center of the target. The State Plane Coordinates for the center of Target 2 are: N=354,100; E=4,001,120 (NAD 1983, Louisiana South). It is believed that this 500-ft buffer zone around the center of the target will be adequate to avoid the object or objects producing the Target 2 magnetics.

If Target 2 cannot be avoided, then it is recommended that diving be undertaken to examine it. The procedures recommended for this examination are ones that have been used in similar situations and settings and are relatively straight-forward. In general, the examination of Target 2 will require the relocation of the target using a magnetometer and precise positioning equipment. Once the target is relocated, divers should, first, examine the bottom in the vicinity of the target to see if any exposed features exist. The target is located in about 16 ft of water and the currently available information suggests that the target is buried, therefore, it is suspected that probing and, possibly, excavations will be required. Work at the target should be limited to only what is necessary to locate and identify the source object(s) and to make an assessment of significance in terms of the criteria established by the National Register of Historic Places.

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CEMVN-PM-RN 17 May 1999

Scope of Services
Remote Sensing Survey of Mississippi River Gulf Outlet, Ocean Dredged Material Disposal Site, Louisiana

1. Introduction. This delivery order requires the performance of a remote sensing survey designed to locate submerged cultural resources which may be impacted by disposal of dredged material in the Mississippi River Gulf Outlet Ocean Dredged Material Disposal Site (MRGO-ODMDS). This area is located along coastal Louisiana at mouth of the MRGO.

Adverse impacts to cultural resources can result from the disposal of dredged material to any significant cultural resources at the site. Adverse impacts include: 1) increase weight of sediments on any significant shipwreck, and 2) localized burial of possible shipwrecks changing their environment and possibly increasing the rate of decay. While the temporary mounding of dredged material may occur within the disposal sites, the mounds do disperse fairly quickly. The disposed sediments are reworked by waves and littoral currents and are moved out of the ODMDS. The direction and speed of currents are variable, but sediments generally drift toward the west under most circumstances.

2. Background Information. The coastal area of Louisiana has been an important navigation route since prehistoric times. Prehistoric vessels were used in Gulf waters to exploit marine resources. Evidence of this has been uncovered at several archeological sites in the state. In the colonial period, waterborne commerce was associated with French and Spanish trade and transportation routes. Later during the American Period water transportation was related to plantations established along various bayous emptying into the Gulf of Mexico. At present, there are 42 recorded shipwrecks in the coastal waters of Louisiana and numerous wrecks in the rivers and bayous.

The number of recorded shipwrecks represents only a small fraction of the wrecks that are expected to exist in the project vicinity. The project area, as a portion of the Louisiana coastal waters, had the potential to contain colonial era (ca. 1718-1803) shipwrecks. The 1979 discovery of the El Nuevo Constante, a Spanish sailing vessel lost in 1766 in similar waters off the coast of Cameron Parish, amply illustrates this potential. The probability for shipwrecks in the project vicinity increase for nineteenth and twentieth century vessels due to the increased maritime commerce in the region.

A brief navigational history of the coastal water of the Gulf of Mexico and an inventory of known shipwrecks in the study area is provided in the report entitled A History of Waterborne Commerce And Transportation Within the U.S. Army Corps of Engineers, New Orleans District and an Inventory of Known Underwater Cultural Resources prepared by Coastal Environments, Inc. This study documents shipwrecks in the vicinity of the project area.

Study Area. The study area consists of the designated ODMDS referenced above. The MRGO Ocean Dredged Material Disposal Site is located at the gulfward end of the MRGO (Figure 1). The ocean disposal is in a 5120-acre site running about 16 miles in length and 0.5 miles wide, parallel to the south side of the channel (Figure 2). In 1977, the EPA approved the site for interim use, based on historical use of the site since 1968.The exact coordinates as provided by Operations Division are:

29° 32'21"N., 89° 12' 38"W.
29° 29'21"N., 89° 08' 00"W.
29° 24'51"N., 88° 59' 23"W.
29° 24'28"N., 88° 59' 39"W.
29° 28'59"N., 89° 08' 19"W.
29° 32'15"N., 89° 12' 57"W.

4. **General Nature of the Work.** The purpose of this study is to locate and identify historic shipwrecks in the above noted project area. The study will employ a systematic magnetometer and side scan sonar survey of the study area using precise navigation control and a fathometer to record bathymetric data. All potentially significant anomalies will be briefly investigated via additional intensive survey and probing of the water bottom (if possible). No diving will be performed under this delivery order.

The project requires historic background research, followed by the intensive survey of the proposed ODMDS area. An inventory of all magnetic, sonar, and bathymetirc anomalies will be prepared. The background research, field survey, and data analyses will be documented in a brief management summary and comprehensive technical report.

5. **Study Requirements.** The study will be conducted utilizing current professional standards and guidelines, including, but not limited to:

> the National Park Service's National Register Bulletin entitled "How to Apply the National Register Criteria for Evaluation";

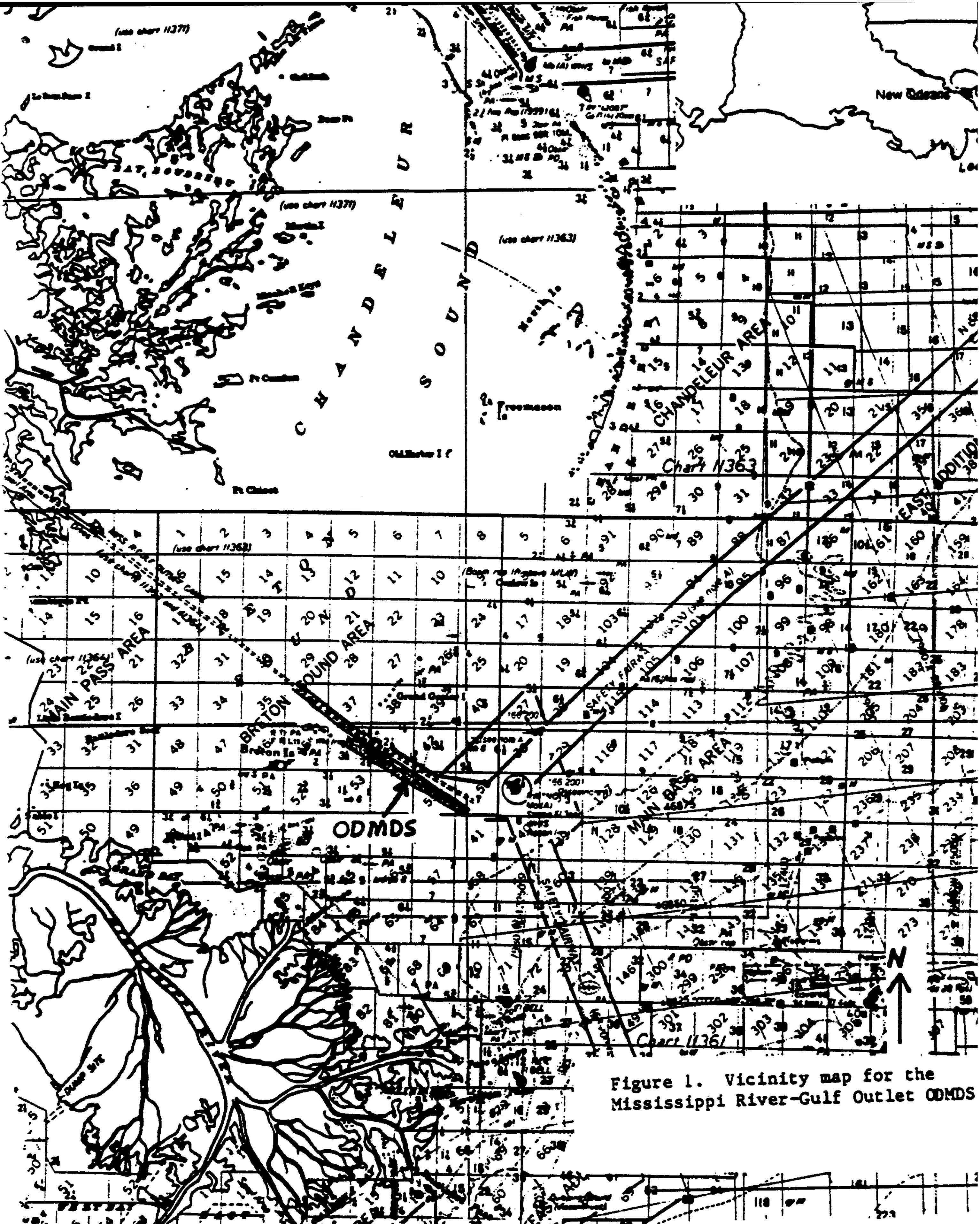

Figure 1. Vicinity map for the Mississippi River-Gulf Outlet ODMDS

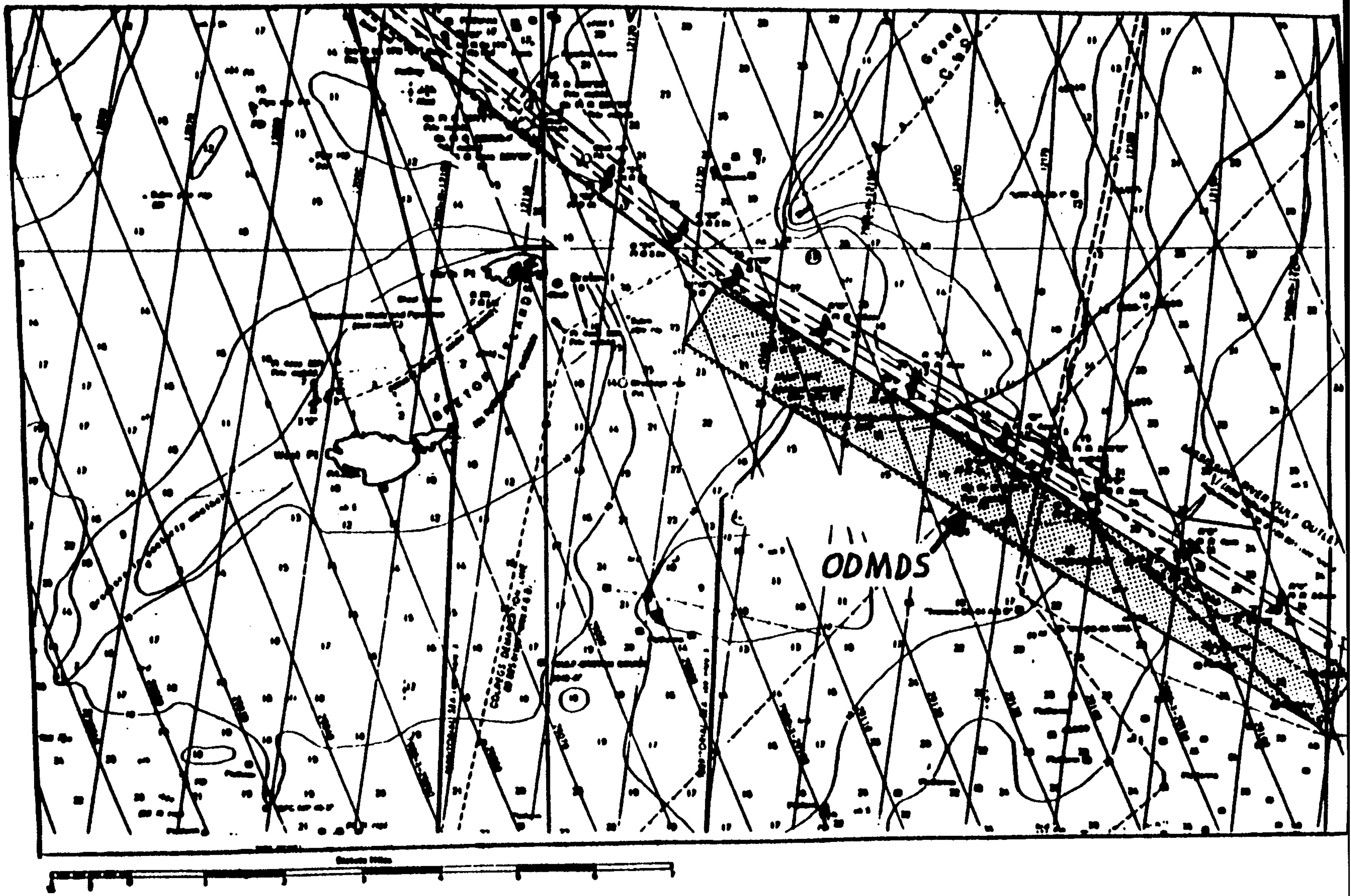

Figure 2. Location of the Mississippi River Gulf-Outlet ODMDS (depths in feet)

the Secretary of the Interior's Standards and Guidelines for Archeology and Historic Preservation as published in the Federal Register on September 29, 1983;

Louisiana's Comprehensive Archeological Plan dated October 1, 1983;

the Advisory Council on Historic Preservation's regulation 36 CFR Part 800 entitled, "Protection of Historic Properties" and

the Louisiana Submerged Cultural Resources Management Plan published by the Louisiana Division of Archaeology in 1990.

The study will be conducted in three phases: review of background sources, remote sensing survey, and data analyses and report preparation.

Phase 1. Review of Background Sources. Due to the availability of the study referenced in Section 2 above, this phase is limited to a review of pertinent information contained in the referenced CEI report, Chief of Engineers reports, and general histories of the parishes covering the project.

In addition to reviewing the cultural background of the project area, geological and sedimentological studies will be examined to develop a concise summary of the physical environment of the project areas. This investigation specifically will examine issues relating to wreck dispersion and preservation as well as channel changes.

Phase 2a. Remote Sensing Survey. Upon completion of Phase 1, the contractor shall proceed with execution of the fieldwork. The equipment array required for this survey effort is:

(1) a marine magnetometer;
(2) a differential GPS positioning system;
(3) a recording fathometer;
(4) a side scan sonar system.

The Contracting firm may propose additional equipment such as sub-bottom profiler and so forth as long as they can provide information in the technical proposal as to what kind of additional data would be obtained from its use. Three estimates must be provided if the contractor does not own the equipment to be used.

The following requirements apply to the survey:

(1) transect lane spacing will be no more than 100 feet;
(2) positioning control points will be obtained at

least every 100 feet along transects;
(3) background noise will not exceed +/- 3 gammas;
(4) magnetic data will be recorded on 100 gamma scale;
(5) the magnetometer sensor will be towed a minimum of 2.5 times the length of the boat or projected in front of the survey vessel to avoid noise from the survey vessel;
(6) the survey will utilize the Louisiana Coordinate System.

Phase 2b. Definition of Anomalies. Additional, more tightly spaced transects will be conducted over all potentially significant anomalies to provide more detail on site configuration and complexity. Probing of the water bottom will be performed at all potentially significant anomalies where water depths and weather conditions permit.

Phase 3: Data Analyses and Report Preparation. All data will be analyzed using currently acceptable scientific methodology. The post-survey data analyses and report presentation will include as a minimum:

(1) Post-plots of survey transects, data points and bathymetry;
(2) same as above with magnetic data included;
(3) plan views of all potentially significant anomalies showing transects, data points, magnetic and depth contours;
(4) correlation of magnetic, sonar and fathometer data, where appropriate; and
(5) high quality reproduction of sonar records related to potentially significant anomalies.

The interpretation of identified magnetic anomalies will rely on expectations of the character (i.e. signature) of shipwreck magnetics derived from the available literature. Interpretation of anomalies will also consider probable post-depositional impacts, and the potential for natural and modern, i.e. insignificant sources of anomalies.

The report shall contain an inventory of all magnetic, sonar, and bathymetric anomalies recorded during the underwater survey, with recommendations for further identification and evaluation procedures when appropriate. These discussions must include justifications for the selection of specific targets for further evaluation. Equipment and methodology to be employed in evaluation studies must be discussed in detail.

A product to be provided under this delivery order and submitted with the draft reports will include CAD graphics and/or design files compatible with the NOD Intergraph system. The maps

and supporting files generated from marine survey data will show, at a minimum, the survey coverage area, the locations of all anomalies and other pertinent features such as: channel beacons and buoys, channel alignments, bridges, cables and pipeline crossings. Tables listing all magnetic anomalies recorded during the survey will accompany the maps. At a minimum, the tables will include the following information: Project Name; Survey Segment/Area; Magnetic Target Number; Gammas Intensity; Target Coordinates (Louisiana State Plane).

If determined necessary by the COR, the final report will not include detailed site location descriptions, state plane or UTM coordinates. The decision on whether to remove such data from the final report will be based upon the results of the survey. If removed from the final report, such data will be provided in a separate appendix. The analyses will be fully documented. Methodologies and assumptions employed will be explained and justified. Inferential statements and conclusions will be supported by statistics where possible. Additional requirements for the draft report are contained in Section 6 of this Scope of Services.

6. Reports.

Management Summary. Three copies of a brief management summary, which presents the results of the fieldwork, will be submitted to the COTR within 1 week of completion of the survey area. The report will include a brief summary of the historical research and field survey methods by waterway, as well as descriptions of each anomaly located during the survey. Recommendations for further identification and evaluation procedures will be provided if appropriate. A preliminary map will be included showing the locations of each anomaly. A summary table listing all anomalies will be included with the maps. The table will include the following information: Project Name; Survey Segment/Area; Magnetic target number; Gammas Intensity; Target Coordinates (Louisiana State Plane).

Draft and Final Reports (Phase 1-3). Four copies of the draft report integrating all phases of this investigation will be submitted to the COR for review and comment within 16 weeks after work item award. The digitized project maps will also be submitted with the draft report.

The written report shall follow the format set forth in MIL-STD-847A with the following exceptions: (1) separate, soft, durable, wrap-around covers will be used instead of self covers; (2) page size shall be 8 1/2 x 11 inches with 1-inch margins; (3) the reference format of American Antiquity will be used. Spelling shall be in accordance with the U.S. Government Printing Office Style Manual dated January 1973.

The COR will provide all review comments to the Contractor within 4 weeks after receipt of the draft reports (20 weeks after work item award). Upon receipt of the review comments on the draft report, the Contractor shall incorporate or resolve all comments and submit one preliminary copy of the final report to the COR within 3 weeks (23 weeks after work item award). Upon approval of the preliminary final report by the COR, the Contractor will submit one reproducible master copy, one copy on floppy diskette, one copy on CD-ROM containing report in .pdf format, and 40 copies of the final report to the COR within 26 weeks after work item award.

7. Weather Contingencies. The potential for weather-related delays during the survey necessitates provision of weather contingency days in the delivery order. Two weather contingency days have been added to the fieldwork. The Contractor assumes the risk for any additional costs associated with weather delays in excess of four days. If the Contractor experiences unusual weather conditions, he will be allowed additional time on the delivery schedule but no cost adjustment.